The JOURNAL OF ELECTRICITY
POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers' Architects' and Builders' News

PUBLISHED WEEKLY

BY THE TECHNICAL PUBLISHING COMPANY, ATLAS BUILDING, 604 MISSION STREET, SAN FRANCISCO CAL.
Entered as second-class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the Act of Congress March 3, 1879.

VOL. XIX. No. 7 SAN FRANCISCO, CAL., August 17, 1907 Yearly subscription $4.50 Single copies 10 cents Back numbers prior to current month 25 cents.

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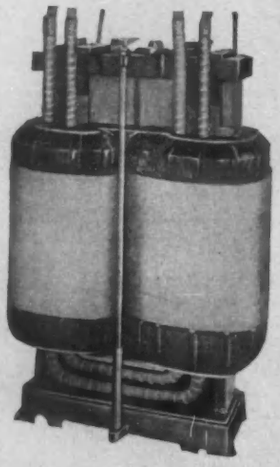

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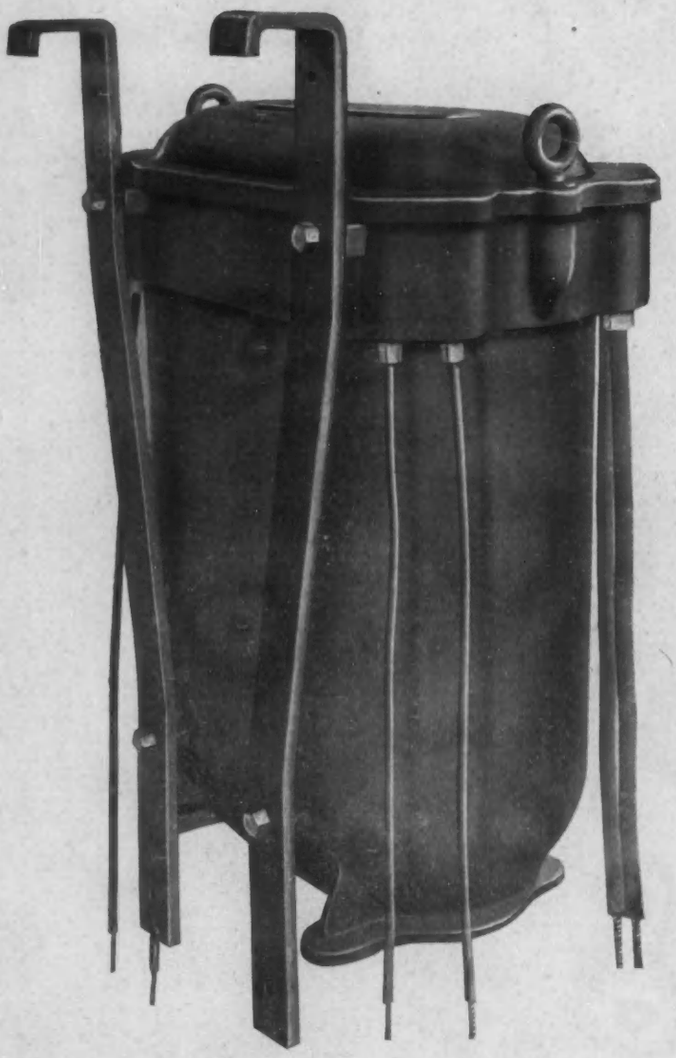

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VOLUME XIX. SAN FRANCISCO, CAL., AUGUST 17, 1907 No. 7

NORTHERN ELECTRIC COMPANY

In May, 1905, Mr. Henry A. Butters of San Francisco, with a corps of engineers under the direction of Messrs. J. B. Robinson and J. P. Edwards, commenced the construction of an electric railroad between Chico and Oroville, California, a distance of 24.8 miles. On April 21, 1906, this 24.8 miles of road was opened for operation.

The equipment consisted of two 56-foot, 40-ton passenger cars built according to the company's design and specifications by the Niles Car Company, Niles, Ohio, and two semi-interurban cars, California type, built by the St. Louis Car Company; two 35-ton steel locomotives built at the company's shops at Chico.

During this period the company took over the Chico Street Railway system, consisting of 5.5 miles of single track.

Almost immediately upon the completion of the Oroville division work was started on the Marysville division between the junction, which is 5.5 miles from Oroville, to Marysville, a distance of 30 miles. This extension was placed in operation in November of the same year. The line is operated by third rail, using overhead construction through the towns of Live Oak, Yuba City, Marysville, Oroville and Chico.

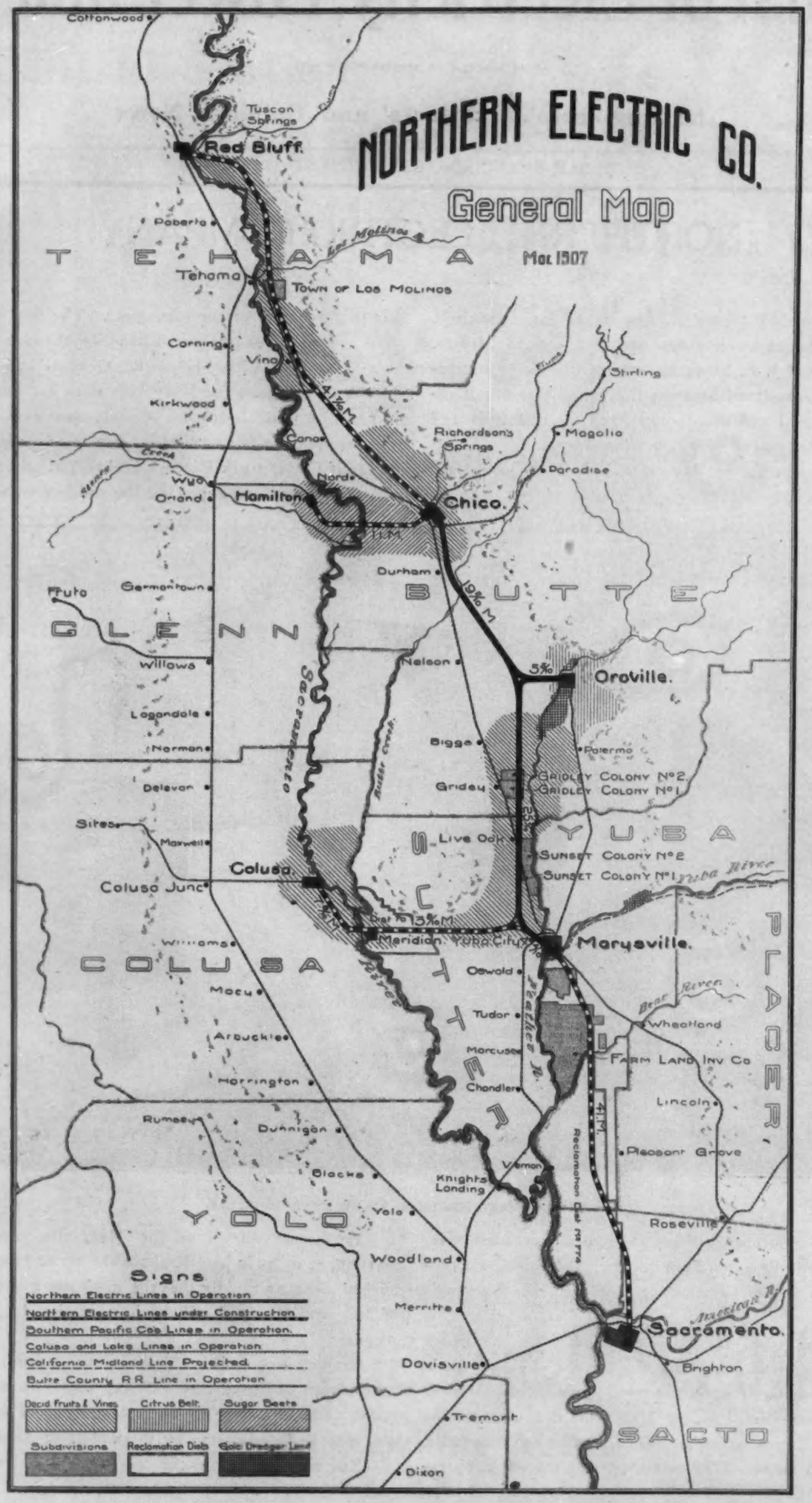
About this time the Marysville mule-car lines were taken over and two double-track, 15-bench, open cars, Coney Island type, equipped with two General Electric No. 67 motors, with St. Louis No. 47 truck Peacock brakes, put on between Marysville and Yuba City, replacing the old horse cars.

BRIDGE CROSSING FEATHER RIVER NEAR OROVILLE

Work was started on the Marysville and Sacramento division, 41 miles in length, about the 1st of January, 1907, and pushed along so rapidly that the work was completed the 19th of July and the road will be in operation by the middle of August.

Grading is now being done on the divisions extending 21 miles from Marysville to Colusa; Chico to Red Bluff, 41.7 miles. The line from Chico to Hamilton, 11 miles in length, will also be in operation by the middle of August.

The right of way of the company's lines presents a beau-


NORTHERN ELECTRIC CO.
General Map
Mar. 1907
Cottonwood
Tuscan Springs
Red Bluff
Paberta
Tehama
Town of Los Molinos
Corning
Vina
Kirkwood
Cana
Richardson's Springs
Magalia
Stirling
Paradise
Orland
Hamilton
Chico.
Durham
Butte Creek
Germantown
Willows
Nelson
Oroville.
Logandale
Norman
Bigge
Palermo
Delevan
Gridley
Gridley Colony No 2
Gridley Colony No 1
Sites
Maxwell
Live Oak
Sunset Colony No 2
Sunset Colony No 1
Colusa.
Colusa Junc
Meridian
Yuba City
Marysville.
Williams
Oswald
Arbuckle
Tudor
Wheatland
Marcuse
Farm Land Inv Co
Harrington
Chandler
Lincoln
Rumsey
Dunnigan
Pleasant Grove
Blacks
Knights Landing
Vernon
Vola
Roseville
Woodland
Merritt
Sacramento.
Davisville
Brighton
Tremont
Dixon
Signs
Northern Electric Lines in Operation
Northern Electric Lines under Construction
Southern Pacific Co's Lines in Operation.
Colusa and Lake Lines in Operation
California Midland Line Projected.
Butte County R.R. Line in Operation
Decid Fruits & Vines
Citrus Belt
Sugar Beets
Subdivisions
Reclamation Distr.
Gold Dredger Land

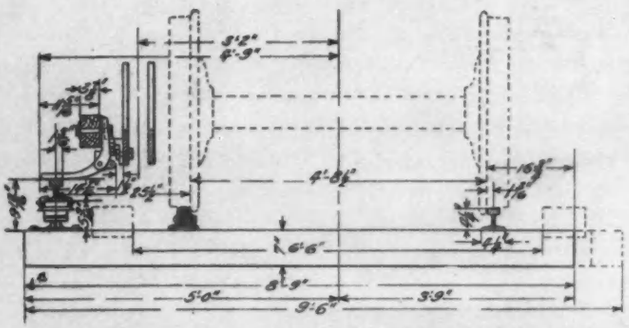
tiful appearance. It is from 80 to 100 feet wide with a pole line for the telegraph and telephone circuits located three feet from the extreme western edge, and the track with the business-like looking third rail on the side in the center of the right of way.

There are very few curves and many fine, long tangents; one of the tangents on the Sacramento-Marysville division being fifteen miles long. The track construction is of standard guage, 4 feet 8½ inches, using A. S. C. E. standard 60-pound rail, bonded at the joints with two 250,000 circular-mil Chase-Shawmut soldered bonds. This track is gravel ballasted from an excellent supply of gravel obtained from the company's gravel pits at Oroville, near the middle of the route. The company has also established a rock-crushing plant, and will use part of its output as ballast, selling the rest for commercial purposes.

The rock crusher is of the rotary type, Gates No. 5, crushing 30 tons of rock per hour, and driven by electricity.

There was considerable discussion at the time of installing of this crusher as to its ability to crush the large "niggerheads" some of which are 12 inches through their smallest diameter. The crusher has, however, fulfilled its task and there is no difficulty in properly crushing the rocks.

The third rail is bonded at the joints with two 400,000 circular-mil Chase-Shawmut soldered bonds. At road crossings, the third-rail construction is carried through fiber conduit, laid in concrete with two copper conductors of 500,000 circular-mils (cross sections) each. The ends of the conduit are filled with oakum and smeared with an insulating compound to keep out moisture. One of the accompanying illustrations shows the general arrangement of track and third rail at a switch.



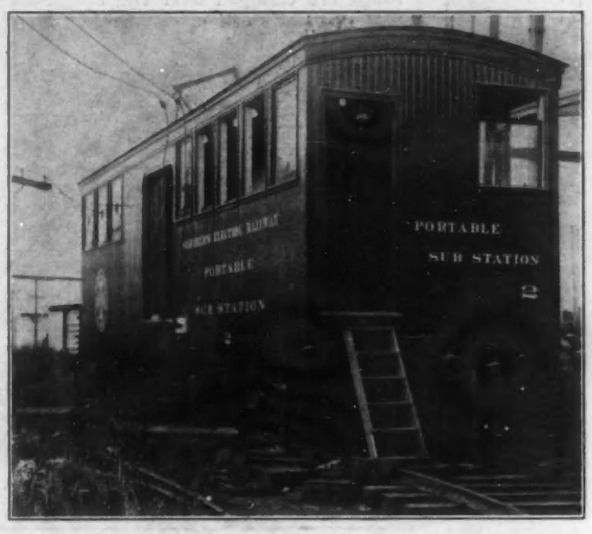
Northern Electric Railway—Track and Third Rail Measurements.

Sub-Stations.

The high-tension power for operating the entire system is purchased from the California Gas and Electric Corporation, deing delivered at the sub-stations at 60,000 volts.

There are five of these sub-stations along the Chico-Marysville division, approximately 9.4 miles apart; four others are being constructed on the Sacramento division of the same type and with the same class of equipment as those already built. With the exception of the Chico station, which is located at the car shops, the buildings are all constructed on the same general plan.

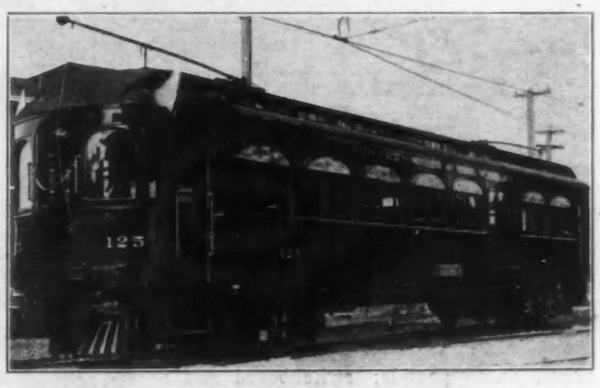
The equipment of each standard sub-station is 800 kilowatt capacity. No. 1, located at Chico; No. 3, located at Oroville Junction; No. 6, located at Marysville; No. 8, located at Nicolaus, and No. 10, located at Sacramento. Each have 800 kilowatt installed, which comprises two sets of three-phase, 60-cycle, 2200-volt, 580 horse-power, Westinghouse induction motor, direct connected, to 400 kilowatt, 600-volt, Westinghouse railway generator, feeding to the main line, through 1,000,000 C. M. cables. The voltage is stepped down from 60,000 volts on the main line to 2200 volts, by means of three



300 kilowatt, oil-insulated, water-cooled transformers. Stations Nos. 2, 4, 5, 7 and 9 consist for the present of a single unit.

At each sub-station the company has provided a pumping plant and a very comfortable cottage of the bungalow type for the operator.

The company has in operation two 60-000-volt portable sub-stations, each 400 kilowatt capacity. At first it was intended to carry the transformers in the same car, but it was deemed more advisable to make two portable transformer stations. These cars were constructed out of old box cars, three 150 kilowatt transformers installed in each. These are used in connection with the portable or the standard sub-stations as occasion demands. The high-tension lines are brought to the transformers through windows with circular



SINGLE CAR IN OPERATION BETWEEN CHICO AND OROVILLE

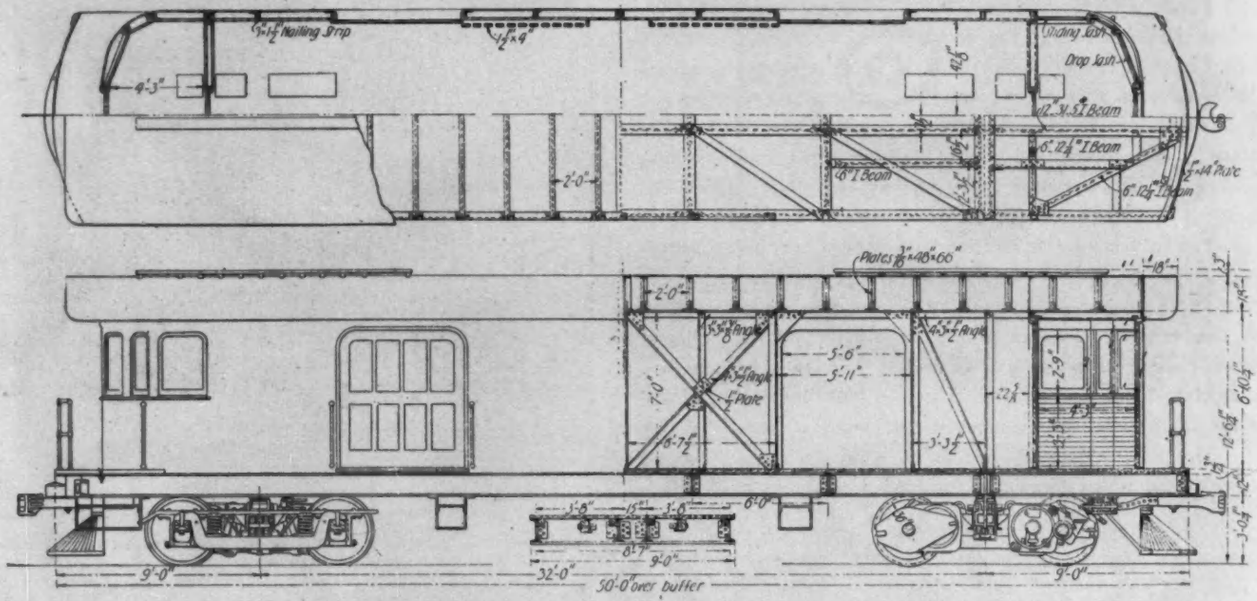
openings cut in the protecting glass. The cars which contain the portable sub-station apparatus were built especially for this purpose. Each is 40 feet long over all, 10 feet wide and 14 feet from rail to roof. On each side of the car body recessed in the sheathing is a level tube with its glass and

bubble unobstructed to view from the outside. Underneath the car, and hanging from special anchors bolted to the bottom of the sills, are eight portable jack screws which are connected with their anchors through pins, so that while the car is being moved they may be hooked up close to the floor. When it is desired to place a car for operation, the jacks are let down, portable tongs are clamped over the rail and the jacks manipulated until the car body is in a rigid position, such that the shaft of the motor-generator set takes a horizontal position, which is determined by the level bubbles.

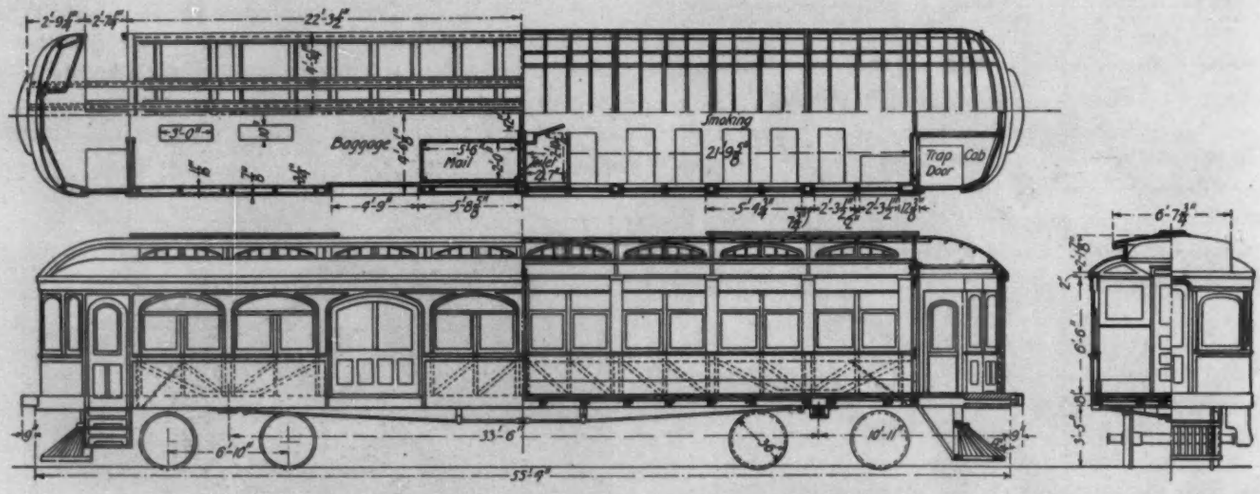
The complete weight of a portable sub-station equipment ready for operation is 90,500 pounds. Some of the details making up this total are: Machinery, 4000 pounds; transformers, 30,000 pounds; switchboard and accessory equipment, 10,000 pounds. The portable sub-stations are equipped with automatic couplers and automatic air brakes.

All the wiring carrying the 2200-volt current from the transformer to the motor-generator is carried in ducts below the level of the car floor, together with the potential and current coils and the auto-starter. Above these ducts the floor is made of wooden grating so that any disturbance below can at once be noted and repairs easily made.

Rolling Stock and Miscellaneous Equipment—Besides the cars which were used on the original Chico-Oroville line, the company has three combination cars and three straight passenger cars purchased from the Niles Car Company and four trailers built by the St. Louis Car Company. Each of the above cars is 56 feet long over all, 9¼ feet wide over sheathing, 13 feet 1⅞ inches high from rail to trolley board and 8 feet 4 inches wide on the interior. In the floor are two center sills, consisting of 6-in. I beams, weighing 12¼ pounds to the foot; two intermediate sills, same as above, and two outside sills, 8-inch I beams 18 pounds to the foot. Each car is provided with plush-upholstered Hale & Kilburn seats and two toilet rooms. The car bodies are mounted on Baldwin M.C. B. Northern Electric standard trucks with steel-tired wheels, with a wheel base of 6 feet 10 inches. The motor equipment comprises four Westinghouse No. 121 motors of 90 horse-power rated capacity each. Two of the six cars have General Electric type M-control and the other four cars have Westinghouse electro-pneumatic control. Each car complete weighs 80,500 pounds.



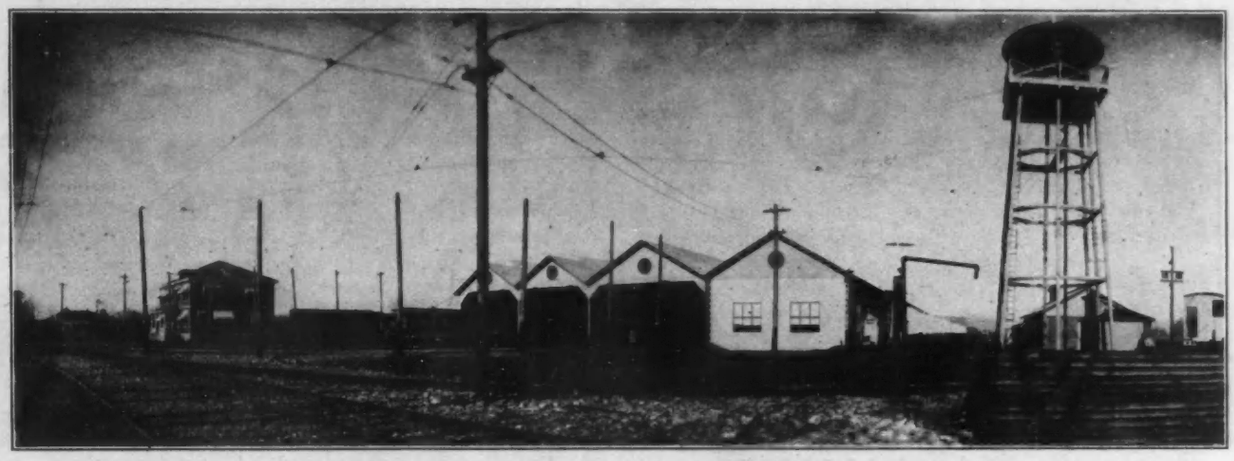
Northern Electric Railway—Steel Frame Express Locomotive.



Northern Electric Railway—Details of Two Compartment Passenger and Baggage Car for Train Operation.

The company has now six cars under construction at the shops in Chico, the dimensions of which appear in the accompanying cut.

These are 56 feet long over all, 9½ feet wide over all, 9 feet 3 inches wide over steps, 13 feet 2 inches high from rail to roof, 4 feet from rail to floor and will weigh approximately



OFFICE, CAR BARNS AND SHOPS

42 tons each, distributed as follows: Car body, 22 tons; trucks, 9.5 tons; motors, 10.5 tons.

They are mounted on Baldwin No. 200 Northern Electric standard trucks, which have 36-inch standard, rolled-steel wheels, mounted on 6-inch axles, with 5x9 inch journals, and 6-inch gear and wheel seats, provided with Symington journal boxes. The motor equipment is the same as that of the other cars, the gear ratio being 2:12. These cars are fitted with A. M. M. schedule Westinghouse automatic air brake equipments and Northern Electric radial couplers, with standard, Master Car Builder coupling heads. The seats are upholstered in Pantasote.

FOUR CAR TRAIN DRAWN BY ELECTRIC LOCOMOTIVE

Besides the two modern electric locomotives there are two steel electric locomotives, with the same truck and motor equipment as the passenger cars and provided with General Electric type M control and Westinghouse schedule ET automatic air brakes. Material is on the ground now for two express locomotives which will be constructed according to the plans shown in the cut, weighing 41 tons each. They will be mounted on Baldwin trucks, with 36-inch steel-tired wheels, M. C. B. automatic couplers, Miner draft-rigging and Westinghouse 121 motors.

These electric locomotives are capable of hauling twenty standard freight cars loaded at a speed of 25 miles per hour.

Thirteen additional passenger cars are being built, ten from the Niles Car Company and three from the Cincinnati Car Company (completed).

The passenger equipment is operated in train service readily as all equipments are provided with multiple control features. Mr. Edwards is perfecting a new pantograph trolley of the roller type which will be operated by the engineer at the head of a train as follows: When the train passes from the fenced private right of way into a town or city the engineer by closing a small knife switch in his cab elevates all of the trolleys of his train, these trolleys are held normally against the roofs of the cars by spring tension. When the engineer closes this controlling switch electro-pneumatic valves are operated which allow air to enter the cylinders of the pneumatic trolley, elevating the same until contact with the overhead conductor is made. As long as the controlling switch is closed the trolleys remain elevated. When the train again passes into a third-rail section the engineer opens the control switch. This breaks the control circuit which has energized the electro-pneumatic valves. The core of the solenoid drops, closes the part of the air supply and opens another part from the cylinder to the atmosphere, allowing the trolley to resume slowly its normal position close to the car roof.

Other miscellaneous equipment consists of two construction locomotives and weighing about 40 tons each; four 16x24 inch cylinder Baldwin steam locomotives, used for construction purposes; one 15-ton wrecking car; 200 40-ton M. C. B. standard flat cars, built by the Fitzhugh-Luther Company; 50 Hart convertible side-dump ballast cars; 40 cars of 60,000-pounds capacity each, and 40 box cars of 40,000 pounds capacity each. These have also been ordered recently: One hundred 80,000 pounds capacity standard box cars to be used in freight service; 150 of these are in service at present.

Shops—There are two main buildings, one of 140x140 feet, one of 120x130 feet.

The two main buildings are divided into several departments.

The car sheds for the cars occupy the main part of the

larger building, while the paint shop, the machine shop, the carpenter shop, the tin shop, truck shop, armature room and the cabinet shop each occupies smaller compartments. The blacksmith shop is in a separate building; there are six forges in this shop, two overhead cranes and one 300-pound Belt hammer.

The trains in operation between Chico, Oroville and Marysville handle freight, passengers, express and mail, interchanging freight with the Butte County Railway.

The passenger trains running between Chico and Oroville make the 25 miles in 50 minutes, and the running time for the through passenger trains between Marysville and Chico is 1 hour and 15 minutes. The 90 miles from Chico to Sacramento will be made in 2½ hours. The trains are all dispatched from a dispatchers' office in Chico, where the general offices are located.

The passenger equipments are capable of a speed of 60 miles per hour; runs as high as 69 miles per hour have been made.

The passenger coaches, electric locomotives, sub-station buildings and equipment, shops, portable sub-stations and transformer stations, distribution systems of third rail and overhead and details of the same have been built in accordance with the original designs and under the direction of Mr. J. P. Edwards, chief electrical and mechanical engineer of the company.

The personnel of the company's organization is as follows:

Henry A. Butters, President; Louis Sloss, Vice-President; Norman Logan, Secretary; A. D. Schindler, General Manager; E. S. Dimmock, General Superintendent; C. S. Compton, Chief Engineer of Permanent Way; J. P. Edwards, Chief Electrical and Mechanical Engineer; H. L. Gibson, Auditor; J. H. Bennett, General Freight and Passenger Agent.

OIL ENGINES.

S. M. Howell.

The production of power by the combustion of crude mineral oil in the cylinder of a gas engine is a problem which has been persistently followed by many inventors; and to a great extent their efforts in this direction have been successful. This is true at least as regards stationary engines in certain situations, where the use of oil fuel is convenient or desirable on account of local conditions, such as proximity to the great oil fields, or in isolated places not supplied with gas, and in buildings which would be endangered by the presence of gasoline or other highly inflammable liquids. But there is also another field for the oil engine whenever it can be made to meet the requirements. The well-known gasoline engine has heretofore been relied upon exclusively in this country as the motor for small boats, automobiles, and other self-propelled vehicles, but the growing scarcity of gasoline has made its more limited use for this purpose a matter of economy, if not a measure of necessity. Herein is the opportunity for the oil engine. An automobile, however, requires a motor of great flexibility and ease of control under wide variations of speed and load, and the use of oil engines in this way has only recently been attempted.

As regards operative principles there is no essential difference between an oil engine and an engine made to use gasoline, but there is an important difference in the character and properties of the respective liquids, and the difficulties encountered in the design of a successful oil engine exist in the nature of the fuel. Mineral oil in its crude state is in reality a complex combination of various liquid and solid hydrocarbons, and these constituents vary greatly in their relative proportions to each other in the several grades and qualities of oil as found in different localities. But for practical purposes in the present instance we may say that crude oil is in general a mixture of either asphaltum or paraffine with kerosene and gasoline. These substances, when separated by distillation, form the commercial products of the oil refinery. Crude oil is, of course, cheaper than the refined product, and is in many localities abundantly available; but the refined article known as kerosene is in such well-established use as to have become a staple article of retail commerce in all parts of the world, and may readily be procured at all times in any locality. Its cost per gallon is considerably less than that of gasoline, and its fuel value is higher. Its comparative cost per unit of fuel value probably does not now exceed one-half that of gasoline, and this difference bids fair to grow wider.

It should be remembered, however, that kerosene is not so rapidly inflammable as gasoline or alcohol, requiring a little more time for its combustion. Therefore a kerosene engine will not run at the high speeds now used in automobile practice with gasoline. Kerosene, moreover, requires heat for its vaporization. Heated air having a temperature of about 500 degrees, Fahrenheit, drawn through a carbureter supplied with kerosene, will absorb the liquid and form an explosive mixture, there being several oil engines now on the market operating in this way, and in a few cases said to be driving automobiles. In order, however, that the engine may be started, an auxiliary device, consisting of a small closed vessel containing gasoline, must be used. This is connected with the vaporizer and arranged in such a way that when the engine has been started and run for a few minutes, the gasoline may be switched off and the oil instantly turned on by the motion of a lever. Only a small quantity of gasoline is required for this, merely a few spoonfuls being used at each time of starting. A few revolutions of the engine on gasoline will heat the vaporizer sufficiently to make the oil fuel at once available. The air receives its heat from the exhaust and becomes hot before coming in contact with the oil in the carbureter. This is a practical and easy method of using kerosene in a gas engine, and is quite reliable. In the case of an automobile engine the gasoline auxiliary may be quite small and compact, containing, say, a quart or two of the liquid, which should suffice for starting purposes for several days.

Another style of oil engines is that known as the internal vaporizer type. In these engines no outside heating device for the air is required, but the gasoline auxiliary just described, or some equivalent means of preliminary heating, must usually be employed. In these engines the oil is injected into the cylinder as the air enters, or in some cases during the return or compression stroke of the piston, in the latter case being sprayed in by a small stream of air under pressure. By this means the oil is atomized and enters the cylinder in the form of a mist which strikes the heated head or some part of the internal surface, and is thereby still further reduced or completely vaporized and mixed with the air.

A common means of gasifying the oil, which does not necessarily involve the use of patented devices, is to use a cast-iron retort of ample size, highly heated by the exhaust, and so arranged that it may be readily cleaned out. The oil is fed into this retort and the vapor or gas conducted to the engine cylinder. This plan is largely used in localities where the native oil has an asphaltum base.

In the case of stationary engines running under nearly constant loads at a regular speed, oil engines have in numerous instances proved entirely satisfactory, but the automobile motor is a somewhat different, and in some respects more difficult, problem, requiring reliable action under rapidly changing conditions, and it is only recently that any degree of success has been attained with the oil engine thus used, but there are great inducements and good opportunities for further improvement. Kerosene or common lamp oil is the kind most suitable for this purpose.—Machinery.

ELECTRIC EQUIPMENT OF DREDGES.

By George L. Holmes.*

The fact that most of the dredges in California, and in fact all of the dredges in Oroville, Yuba and Folsom districts are driven by electricity has caused their development along different lines than in districts which are not so favored. As a power for dredging purposes, electricity cannot be excelled if proper precautions are taken and the installation is correctly designed. Those, however, who have been using steam dredges and have remodeled their equipment, installing motors in place of their engines, have come to grief. The reason is plain; when running by steam, the boilers, engines, etc., are usually designed so that the engines will stall before the driven parts are strained to a rupture. If the dredge-master hangs a monkey-wrench or an old boot filled with gravel on the safety-valve lever and carries a higher pressure than was intended, for a short time, to carry him through a tough piece of digging, he is correspondingly careful while the increased steam pressure is being carried. Electricity, on the other hand, is brought to the dredge from a power plant generating perhaps thousands of horse-power, over wires of a size sufficient to prevent an excessive "line loss" and the main motors are, in the latest practice, usually operating under the full voltage of the line. The induction motors in most cases will, before stalling, deliver for a short interval from one and one-half times their rated capacity to twice or three times. Of course precautions are taken, the motors are fused to cut out 25 per cent over-load, over-load circuit breakers, etc., are installed; in fact, everything is done to prevent an excessive load being transmitted to the dredging machinery. These precautions however really do not prevent entirely the transmission of severe shocks and strains to the machinery, as, for instance, when the buckets strike a large boulder or other comparatively immovable obstacle and are practically stopped instantly thereby, while the motor jumps from its normal power-delivery to two or three times the normal before the fuses or circuit-breakers act. Of course the cut-outs are with "electrical speed," but even so, there is an interval between the stopping of the bucket and the blowing of the fuse in which mischief may be done. In modern practice, the designer selects the motor which, with his previous knowledge of the art, he believes will be sufficiently powerful to drive the buckets, in the average digging to be encountered in the tract to be worked, at the maximum efficiency of the motor. In heavy ground this motor will, of course, be overloaded and vice versa. The digging apparatus then will be designed to withstand the pull caused by this motor when running at 50 per cent overload and with an ample factor of safety beyond this.

In the Oroville district we find that the electric power is manipulated in various ways, to serve the required purposes. Some, with a sort of insensate fear of the higher voltages, transform the current on shore to 440 volts, use a ponderous cable for conducting the current on board, and have a comparatively heavy line-loss on account of the low voltage. Others carry the current on board at 4000 volts and transform to 440 for all the motors, while some use the current at 2000 to 2200 volts for the larger motors and transform only for motors under 50 horse power. Each practice has its adherents and its wordy arguments. The best plan, all things considered, is undoubtedly the last mentioned, inasmuch as the losses from line, transformers, etc., are minimized. This plan has been adopted as best by the Yuba and Folsom companies. The usual equipment for a 5 cubic foot continuous bucket dredge of the type commonly in use at Oroville consists of the following:

75 or 100 horse power variable speed motor for driving buckets.

50 horse power constant speed motor for main pump.

20 horse power constant speed motor for screens.

20 horse power constant speed motor for stacker.

5 horse power constant speed motor for priming pump.

40 horse power constant speed motor for sand pump.

20 to 25 horse power variable speed motor for mooring winch.

3 to 30 kilowatt O. D. type transformers for the motors under 50 horse power.

1 to 10 kilowatt O. D. type transformer for the lighting circuits.

120 to 175 16-candle power incandescent lamps.

In the best practice the current is brought aboard the dredge through a cable composed of three strands of insulated conductor well covered and protected with jute and drawn through a rubber hose for further protection against water. Iron-armored cables have been tried, but their tendency to kink, break insulation, and burn in two, makes them undesirable. Three terminal panels are provided, one on either side of the rear of the deck house and one on the bow gauntree, for the connection of the cable when the dredge is working on the spud or on the head-line. From these terminals the current is carried through insulated conductors to the switch-board in the pilot-house. The switch-board may be subdivided into three panels; a receiving panel and two distributing panels. The receiving panel is usually provided with an oil-switch and automatic circuit breaker and with volt and ammeters of the long-scale type. From this panel leads are taken to one distributing panel and to the transformers at the full voltage of the incoming line; from the transformers a lead is carried to the second distributing panel for the lower voltage circuits. Oil-switches are provided for each of the motor circuits, so that each of the lines may be cut out separately in case of accident to the particular motor which it supplies.

The motors in use in all three of the districts named are all induction motors, the direct current having been found not suitable for the service. There is no doubt that the direct current control for variable speed motors is more efficient and economical than the rheostatic control used on the A. C. motors, but the severe service and the liability of stalling a motor at any time, makes the D. C. motor out of the question.

For the variable-speed dredge-motors, the digging motors principally, use has devised, or caused to be devised, a type of rheostatic control commonly known as "dredge resistance;" it is the ordinary form of gird resistance, but the amount of heat radiating or dissipating surface is proportioned so that the motor may be run continuously on any notch of the controller for a considerable period of time.

In the variable-speed induction-motors there is of course a great loss of efficiency when running on the lower notches of the controller, but as the power is comparatively cheap, the actual monetary loss is small in proportion to the earnings.

*Reprinted from "Dredging for Gold in California."

MODERN APPLICATION OF ELECTRICITY TO MINES.*

By Charles Pratt Sparks.

The importance of increasing the application of power to reduce labor costs, renders the use of electricity a matter of interest to all mine owners, as no other system has equal flexibility in distribution or is so well adapted to meet every form of drive above or below ground.

Economies.—The principal economies resulting from the use of electricity are through:

(1) Reduced stand-by charges.

(2) Small loss in transmission.

(3) High efficiency of the electric motor.

(4) The lower capital cost of producing and transmitting energy.

The cost of electric power varies over wide limits and depends upon:

(1) The size of the undertaking.

(2) Capital outlay (influenced by locality).

(3) Cost of fuel and circulating water (if water-power is not available).

(4) Load factor.

Where electric driving has been adopted on an extensive scale, the load-factor at the power-house is between thirty and forty per. cent. This high load-factor makes the fuel-cost important. With the cheap fuel available at collieries the cost of the coal only accounts for one-quarter of the total cost at the power-house, whereas, when fuel is purchased, its cost may amount to more than one-half of the total. Thus the advantage to be gained in applying electric driving in mines, where fuel has to be purchased, is much greater than the economy obtained in colliery working.

The following figures of the Powell Duffryn Company are representative costs:

Power-House.

Low-speed, steam-driven generators equal 3000 kilowatts.
(Largest unit, 1500 kilowatts.)

Average horsepower of motors at work during the last year:

Haulage	2,900	horsepower
Winders	180	"
Fans	380	"
Pumps	340	"
Screens	240	"
Auxiliary motors on surface	480	"
Total	4,500	horsepower
Output of power-house for 12 months	4,800,000	units
Average cost of coal during year	5s	per ton
Coal consumption per unit	3.7	pounds
Running costs	0.18d	
Interest and depreciation charges 10 per cent on capital	0.17d	
Total cost per unit	0.35d	
Average load-factor	36	per cent

Advantages for Underground Work.—The difficulties of ventilation, even when no gases have to be dealt with as in collieries, render the application of steam difficult, and until electricity was applied compressed air was the only available agent for the inner workings. In consequence of the high capital and running costs of compressed air, the haulage-gears were generally steam-driven, being placed on the surface or at the bottom of the intake shaft.

Principal Applications.—While electric motors are now used for every form of colliery drive, the most important applications in England have been for haulage. Owing to the intermittent character of this work, the percentage saving by remodelling existing haulages is greater than that obtained in modifying any other part of a colliery equipment. Next in importance to haulage is the use of electriicty for pumping, which has received great impetus through the development of the high-lift centrifugal pump. Owing to the comparatively large powers, the foregoing uses attract special attention, but the use of electricity for detailed purposes, while already of importance, will attract even greater attention in the future. Great progress has been made in electric coal-cutting, which not only reduces the cost of winning a ton of coal and increases the percentage of large coal won, but allows the thinner seams to be profitably worked, thus increasing the coal reserves. The possibilities of electric drilling are now coming to the front, and it is in the extension of the use of electricity in detail that the future reduction in mining costs are to be looked for.

Electric Winding.—While there is a substantial saving in the running costs, owing to the low cost of fuel available at collieries, this saving is at present counterbalanced by the interest charges, due to high capital cost of electric winding plant; in consequence, this is the last part of a colliery plant to recive attention in conversion from steam to electric working. Where the hours of winding are long, or the cost of fuel high, a substantial saving can now be made by adding electric winding, the whole power required being obtained from a single power-house.

Haulage.—In addition to the lower power costs the first advantage gained with electrically-driven haulage is the freedom in choice of position and speed, and, second, the decreased wear and tear on the ropes and road through the steadier drive. In collieries it is seldom possible to consider the use of electric locomotives, owing to the difficulty of sparkless collection of current, but where mines are sufficiently dry and gradients not excessive a considerable gain in efficiency and maintenance will result in operating by electric locomotives in place of main and tail haulage.

Pumping.—The comparatively high speed at which it was necessary to run the motors in order to keep down the capital cost was a disadvantage in the first pumping applications when three-throw pumps were driven by ropes or gearing, but the combination of the electric motor with the high-lift centrifugal pump has resulted in a great advance on previous methods of pumping.

The high speed and purely rotary motion has much reduced the capital cost and the space occupied compared with any previous system. The Powell-Duffryn Company have several high-lift centrifugals at work. At Lower Duffryn a seven-stage Sulzer pump, delivering 800 gallons per minute against 1150-ft. head, is driven by a 3000-volt, 50-cycle, 1450-revolution induction motor supplied by the Electrical Company, rated at 450 b. h. p. The motor is of the slip-ring type, and is started by varying a liquid resistance in the rotor-circuit. It is generally run seven hours each night when the haulage machinery is shut down, and thus equalizes the load on the power-house. Tests show an over-all efficiency from motor terminals to output of water at surface of 65 per cent when delivering 798 gallons per minute against a head of 1115 feet, suction 20 feet, pump speed 1480 revolutions per minute.

In the Brithdir seam at Bargoed a five-stage Simpson pump is at work, driven by a 3000-volt, 50-period, Westinghouse squirrel-cage induction motor, running at 1450 revolutions per minute, delivering 800 gallons per minute against 700-ft. head.

Two turbine pumps have just been completed for the East Elliot pit, each capable of delivering 1300 gallons per minute against a head of 1650 feet. These pumps are of the six-stage Simpson type, and are to be driven by Westinghouse 3000-volt, 50-period, squirrel-cage induction motors, started by autostarters. The guaranteed efficiency from input at motor-terminals to output at surface is 69 per cent. It is proposed to run these pumps at night, when the haulage gears and other machinery are shut down, thus providing a steady lead for the power-house, this being equipped with Nuernberg gas-engines of 1200 and 2400 b. h. p. driven from the surplus gas of the by-product coke ovens.

*Paper read before the Engineering Conference of the Institution of Civil Engineers.

THE ELECTRIC POWER EQUIPMENT U. S. S. NEBASKA.

The battleship Nebraska, the latest big fighting vessel to be added to the United States Navy, was built at the yards of the Moran Bros. Co., Seattle, Wash. This battleship is of the class known in naval circles as "Virginia and class," which comprises a series of five similar ships.

The Nebraska, now in commission at the Puget Sound navy yard, is 441 feet in length, with an extreme width of 76 feet and a displacement of approximately 15,000 tons at normal draft of 23 feet 9 inches. The battleship is driven by twin propellers 17 feet in diameter. The main engines, of which there are two, have a rated capacity of 9,500 horsepower each, and were dseigned to drive the ship with normal load draft at a speed of 19 knots per hour. The trials of the engines showed, however, that they were capable of developing nearly 11,000 horsepower each, and could propel the vessel at a speed considerably above the designed speed, if necessary.

The electrical equipment installed on the Nebraska, besides the power service, comprises a lighting system of 1,100 incandescent lamps, 10 arc lamps, and six searchlights; a very complete communication system; and a complete wireless telegraphy outfit.

Electric current is generated in four dynamo rooms, in each of which are two dynamo sets. Six of the dynamos are 50 kilowatts capacity, the remaining two being 100 kilowatts output each. They are all manufactured by the General Electric Co., and are compound wound, delivering direct current at a pressure of 125 volts. Vertical, compound, direct-connected engines, taking steam at 150 pounds pressure, are used to drive the generators, the engine and generator of each set being secured to a common base.

The main switchboard, in one of the dynamo rooms, is of lacquered slate. An auxiliary switchboard controls the six 30-inch searchlights.

Nearly all the auxiliaries on board the ship are electric driven, with the exception of the steering gear and main anchor gear. The power equipment for these electric-driven auxiliaries comprises 120 motors ranging in size from one-half to fifty horsepower, and aggregating a total of over 1,100 horsepower. Besides these, there are some sixty electric-driven bracket and desk fans.

Ventilation for the ship is furnished entirely by electric-driven ventilation sets, artificial ventilation being supplied to every compartment on the ship. Thirty-three fan sets are used, the motors for driving them ranging in size from one-half to eighteen horsepower. The latter size is used to drive 90-inch "Sturtevant" blowers, two of which furnish air to the dynamo rooms.

Speed control with a speed variation of twenty per cent is obtained on all of the ventilation sets. On motors of over one horsepower in size this is accomplished by varying the motor field strength. On sizes of one horsepower or under the speed regulation is obtained by means of adjustable resistance in the motor armature circuit.

For handling heavy weights on the upper decks, six winches are provided. Each winch is driven by a 30-horsepower series-wound motor, designed to be capable of hoisting a maximum load of 2,900 pounds at the rate of 230 feet per minute, or by means of a system of reduction gearing hoist, 13,000 pounds at the rate of fifty feet per minute. A drum-type controller, connected to the motor circuit, provides five motor speeds in either direction.

For handling boats and launches, four cranes landing on the upper deck are provided. The largest of these cranes has a capacity of 33,000 pounds and the hoisting equipment is designed to hoist this load at the rate of twenty feet per minute. The next largest crane has a load capacity of 17,000 pounds and maximum hoisting speed of forty feet per minute. The two remaining cranes have a capacity of 10,000 pounds each and a maximum hoisting speed of forty feet per minute.

Each of the cranes is equipped with two series wound motors, one motor for hoisting and lowering the boats, the other for either rotating the entire crane or trolleying the load back and forth. Fifty-horsepower motors are used for hoisting on the two larger cranes and 30-horsepower on the two smaller.

A double-drum type controller on each crane provides for eight speeds of each of the motors in either direction of rotation.

Considerable power is necessarily required to handle ammunition and to operate ordnance equipment on any battleship. On the Nebraska, power for this purpose is furnished entirely by electric motors. For handling ammunition for the guns of 6-inch calibre or smaller, twenty-one endless chain ammunition hoists driven by 2½-horsepower motors are used. For each of the 8-inch and 12-inch guns in the turrets, ammunition is hoisted up rails in a car by means of a steel cable wound around a drum driven by an electric motor. For the 8-inch guns these motors are of 11-horsepower capacity, and for the 12-inch guns are of 30-horsepower capacity. These large size motors are required because of the high rates of speed at which the cars are hoisted.

The turret guns are elevated and depressed by motors working through a system of gearing. A motor generator set is provided for each of the elevating motors and by means of an adjustable resistance in the field of the generator of this set the generator voltage and consequently the elevating motor speed can be varied at will.

For turning the turret as a body, two shunt wound motors in each turret are used. These motors operate with their armatures in series and are of 15-horsepower capacity for the broadside and 35-horsepower capacity for the forward and after turrets. The Ward-Leonard system of control is used, a special drum controller giving about twenty-five different speeds of rotation in each direction.

It may thus be seen that the power equipment for each gun in the turrets consists of a motor for hoisting ammunition, a motor for elevating and depressing the gun and a motor generator set, besides the motors for turning the whole turret.

In addition to the motors mentioned, motors are used to drive the workshop machinery, whip hoists, laundry machinery, bakery machinery, and drainage and fresh-water pumps.

The distribution is on the two-wire, 125-volt system, the wires being run in conduit throughout the ship, special attention being paid to maintaining water-tightness. The power distribution is accomplished through sixty-two feeders, varying in size from 75,000 to 657,000 circular mills. The smaller motors are grouped from two to six on one feeder, but the larger motors have feeders direct to them. — Pacific Builder and Engineer.

THE FUEL-TESTING PLANT OF THE UNITED STATES GEOLOGICAL SURVEY, NEAR NORFOLK, VIRGINIA.

By C. T. Wilkinson.

The fuel-testing work of the United States Geological Survey should be followed with close interest by all engineers, not only because it is important to all consumers, but in this branch of the Government work, because it is undertaken to point out new paths for the development of the natural resources of the country by locating, classifying and testing all kinds of available fuel.

In Europe, where the fuel resources are now fully known, there has been no need for so powerful an organization as that which is now rapidly making the resources of this country as well known to the public as that of the older European countries.

Accurately compiled results of the more recent work of this branch will soon be published, as the following particulars of the plant in Virginia will doubtless be of interest. Besides the machinery shown in figure 1, the plan illustrating the location of the boilers, gas producers and engines, new apparatus has been added as follows: A 250 horse-power Babcock & Wilcox boiler, with superheater, provided with a Roney stoker; a Jones underfeed stoker with fan, added to one of the old Heine boilers; two direct-current DeLaval turbine sets, rated 300 horse-power at 9000-900 revolutions; also three Green Fuel Economizer Company's induced draft fans.

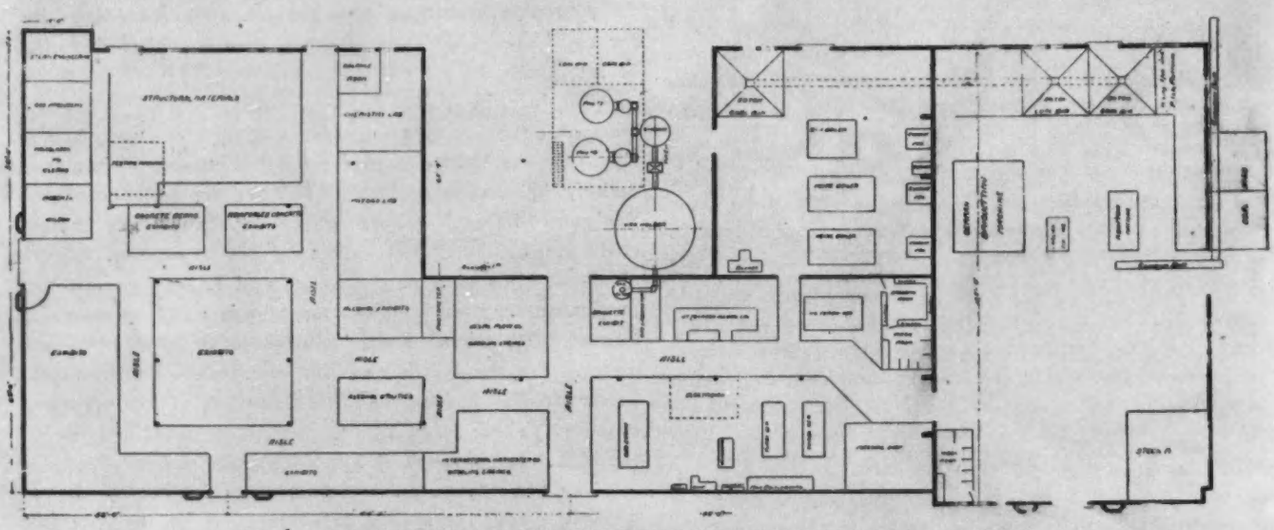


FIG. 1. PLAN SHOWING LOCATIONS OF THE BOILERS, GAS PRODUCERS AND ENGINES

The method of the work planned for this section is to be slightly changed, so that instead of testing a great number of coals, more tests will be made of the same coal, different sizes and different methods of stoking or feeding, etc., being employed with the object of determining the most economical performance under different rates of combustion and the best ratios of grate and heating surfaces.

The Babcock & Wilcox boiler will be placed beside the two Heine boilers which have been brought from St. Louis, all three having been provided with induced draft apparatus in order to get a wide range of capacity. The Heine boiler provided with the Jones stoker has the usual arrangement for forced draft. The Babcock & Wilcox boiler was inserted partly to enable tests to be made of the same fuel with different types of boilers. It serves to represent the types employing a perpendicular flow of the gases through the tubes, the parallel flow types being represented by the Heine boilers. The Heine boilers have been rebaffled or partitioned in such manner as to practically double their length by compelling all of the heated gases to pass along the entire length of the tubes twice. An additional alternating current turbo-generator set may be installed to supply power for external and exhibition purposes.

The steam-engineering division, which has now practically succeeded in isolating the performance of the boiler from that of the combined performance of the boiler and furnace, will carry on further tests with the object of still further determining the performance and efficiency of the furnace alone.

Producer-Gas Section.

The apparatus in the producer-gas section is arranged as shown in figure 1 and figure 2. The producer-gas immediately on entering the building, passes through the meter and thence to the Westinghouse gas engine transferred from the St. Louis plant. Some slight changes have been made in this apparatus: Producer No. 7 has been provided with a water seal at the base to permit the ashes to be removed without admitting air, and several holes have been bored at different heights, to be used for extracting samples of the gas. The purifying apparatus, consisting of the usual chamber containing iron filings and wood shavings, has been removed, since experience indicates that the danger from impurities has been considerably exaggerated. A special steam pipe has been provided to insure a steady water pressure, since the pressure of the supply mains fluctuates considerably.

The gas engine is belted to a 200 kilowatt Bullock generator brought from St. Louis, which serves to drive the motors for the apparatus in the building, the machine shop, the briquetts plant, the elevators and the conveyor. Any additional load required is obtained by means of a water-box resistance, which can be regulated by the switchboard attendant so as to maintain a steady full load value.

The plans of this section include the following determinations:

The proper length for a test run, the effect of the size of the coal, the best depth of the fuel bed, the effects of rapid load variations, the maximum returns from the different fuels, and the response of a producer plant to sudden demands for power.

A new work of great importance is being undertaken by the gas engine section. Its equipment includes two 15 horse-power, 250 revolutions per minute Otto gas engines; two 15

horse-power Nash Company's engine; one 2 horse-power International Harvester Company's engine; and two John Deere engines rated at 14 and 18 horse-power respectively. Experiments will be made covering the whole range of this field, but for the present the work will be confined chiefly to examinations of different carburetters with the object of showing the lines along which a more efficient method of vaporization may be obtained. The other more prominent work is the examination of the kinds of fuels available, with special reference to gasoline versus alcohol, and an investigation of the use of kerosene as fuel for this class of engines; an investigation necessitated by the increasing demand of gasoline and the limited supply available.

The study of the destructive distillation of the coal and its combustion in gas producers, coke ovens and furnaces, especially from the standpoint of physical chemistry, will be undertaken by several divisions.

The briquetting division, which occupies the large room at the end of the building, is putting down one large additional German briquetting machine, while the previous apparatus

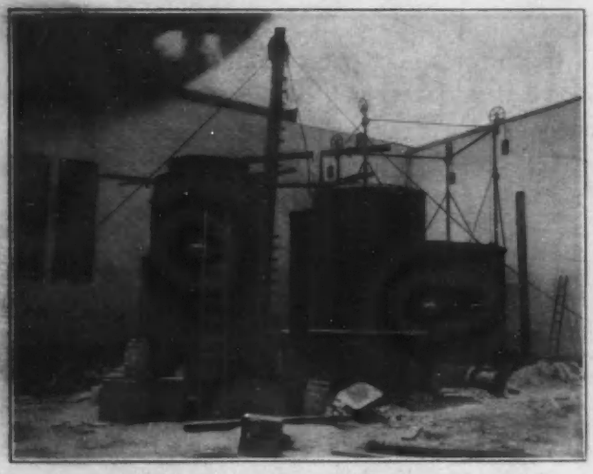


FIG. 2. GAS PRODUCER PLANT

of English and American manufacture, that was used at St. Louis is installed in the same room. The work of this division will be chiefly the manufacture of briquetts from various run-of-mine coals of the Eastern fields, which will be tested on war vessels under the direction of the steam-engineering division.

The further fuel testing work of the Geological Survey includes tests dealing with the spontaneous combustion of stored coals, in which an effort will be made to simplify the methods for its preventations, while a corps of specialties will be detailed to investigate closely the whole subject of explosions in coal mines with a view to eliminating danger from this source.

THE OPEN-TANK METHOD FOR THE TREATMENT OF TIMBER.

A marked saving in three directions—cost of equipment, of materials and labor, and of transportation—is being effected by the introduction of what is known as the "open-tank" method of treating timber. The general practice of preserving timber has hitherto been retarded by the heavy cost of closed retorts and other complicated equipment ordinarily used, and the need of experienced men to operate them. Not until the kinds of timber long used and considered almost indispensable for certain purposes grew scarce and rose alarmingly in price, did wood users consider seriously the possibility of consuming less wood by making it last longer.

As a rule, preserving plants have been located at lumber centers, where a large business might be expected, and it has often been necessary to pay transportation charges to and from the treating plant on timber needed for local uses, such as for ties, posts, and poles. The equipment of the open-tank method, which consists of an open tank, capable of withstanding heat and either equipped with steam coils or so arranged that fire can be placed underneath, is so simple and comparatively so cheap that it is within reach of the smaller companies, contractors, and farmers. The fact that it is portable gives it a distinctive value, since it can be taken, if necessary, into the heart of the forest, and even into the mountains.

One of the chief advantages of the open-tank process is that it can be effectively applied to parts of timbers which are especially subject to rapid decay, such as the butts of fence posts and telephone poles, without wasting preservatives on other parts. It is also especially adapted to the treatment of mine props, small dimension timbers, cross-ties, piling, and shingles, and timbers in small sizes of loblolly pine, black and tupelo gum, western yellow pine, and lodge-pole pine, and similar kinds of wood. Fairly good results have been obtained in the treatment of aborvitae, chestnut, and red oak, but the experiments thus far do not warrant the application of the method to the treatment of piling and ties made of these woods.

The open-tank treatment is being rapidly developed, and while it ordinarily does not secure so deep a penetration of the chemicals as the retorts, it is sufficiently thorough to protect timber for practical purposes in many situations, and it is probable that future experiments will further extend its application.

Circular 101, just issued by the Forest Service, United States Department of Agriculture, describes and illustrates the open-tank equipment. It can be had upon application to the Forester, United States Department of Agriculture.

GERMAN WIRELESS TELEGRAPH STATIONS.

According to statistics issued in Germany, there are now 641 complete stations of wireless telegraphy on the "Telefunken" system, whilst the total for the various systems throughout the world is put at 1,550. The stations of German origin are distributed over 31 countries in Europe, America and Asia, and they are composed partly of land and coast stations and partly of ship stations, and portable plants for military purposes. At present there are 174 stations of the land and coast class, mainly with a radius of activity of 124 miles at most, although some of them extend to 310 miles, 430 miles, and over. Germany stands at the head with 36 stations, which are mostly on the coast of the North Sea and the Baltic, including the large experimental station at Nauen, which is claimed to cover a distance of 1,860 miles. The United States ranks second with 20 stations, including Fire Island, Washington, New Orleans, and San Francisco; Russia has 17 stations, one of which is at Vladivostock, and has an oversea scope of 620 miles; Austria-Hungary has 10 stations; Denmark and Spain seven each; Holland six, and Norway and Sweden five each. Outside of Europe stations have been provided for the Argentine, Brazil, China, Cuba, Mexico, the Philippines, and the Sandwich Islands. These stations are largely in State ownership and belong to the marine, post and telegraph services, etc. As to the stations on ships it is stated that 22 are equipped on German and Dutch vessels and 389 on warships. The German warships have 140 stations, those of Russia 126, those of the United States 43, Sweden 19, Austria-Hungary 17, Holland 10, Norway eight, Argentine six, Denmark, Spain and Brazil five each, Greece three, and Farther India two. Portable military stations have been delivered to the extent of 14 for Germany, eight for the United States, six for China, four for England, four for Austria-Hungary, and others for six other States.

The JOURNAL of ELECTRICITY
POWER AND GAS
WITH WHICH IS INCORPORATED
The Engineers' Architects' and Builders' News

Published Weekly by

THE TECHNICAL PUBLISHING COMPANY

SUCCESSORS TO
The Journal of Electricity Publishing Company
304 Atlas Building, San Francisco.

Yearly subscription, $2.50. Single copies, 10 cts. Back numbers prior to the current month, 25 cts. Foreign subscription, $4.00. Subscriptions cannot be begun with back numbers. Manuscripts submitted must be accompanied by postage to insure return.

Address all communications and make all remittances payable to The Technical Publishing Company.

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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," with which is incorporated "The Engineers', Architects' and Builders' News."
Entered as second-class matter at the San Francisco Post Office, August 15, 1899.
Entered as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.

VOL. XIX AUGUST 17, 1907 No. 7

EDITORIAL.

THE COMING ELECTION.

In the coming municipal election there seems grave danger lest the one paramount issue be lost sight of, with dire results. There is only one question of vital moment to be decided by the voters of San Francisco, and that is whether the reins of city government once more are to be handed over to the Union Labor Party, under whose reign such disgraceful chapters of incompetency and dishonesty have been written in the municipal history.

With such a danger distinctly imminent it is extraordinary that there is no effort to combine the forces of intelligent and honest voters against the political control of Labor Unionism. San Francisco has suffered over and over again from the amazing folly of splitting its best vote into camps of party politics, which so obviously have nothing whatever to do with the question of honest and efficient government.

It is true that members of the Republican Party may take heart from the returns of last Tuesday's primary election, and consider that they are warranted by those figures in believing that it would be possible to elect a Republican ticket next November. But the returns of this week's election will bear closer analysis, and will reveal deeper significance than what the figures bear on the surface.

Although, at this writing, the returns are not complete, the total vote of all parties cast on Tuesday will approximate 22,000. That figure is in itself a satisfactory sign in that it is over one-third of the total registered vote, and about twice the primary vote of last year, which demonstrates that the public conscience has been aroused in considerable measure to a sense of civic duty.

While the total Republican vote, approximating 13,000, outnumbers more than two to one the Union Labor vote cast, about 5,300, yet it is known to careful students of the political situation that a very considerable proportion of the Republican vote cast at the primaries will support at the city election the Union Labor ticket; and, on the other hand, the vote cast by the Union Labor party last Tuesday does not, it is believed, show one-half of its real strength at the city election.

Until the personnel of the three tickets is made up it is probably idle to hazard a guess as to the results of next November's poll. But, in the light of past history, it is important that no one who desires to see San Francisco delivered from the thralldom of Labor Unionism in municipal government, should be misled by the returns of the primary election. In the opinion of experienced politicians, it would be quite possible for the figures of the primary election to be almost entirely reversed next November, and out of a vote of, say, 35,000, to find the Union Labor ticket at the head with 15,000, the Republican with 13,000, and the Democratic with 7,000.

The danger of a repetition of Labor Union control is certainly too serious to admit of any half-way measures. To attempt to combat that danger with a divided front, is folly.

There is but one issue. Why, then, should there be three tickets in the field? Absolutely no difference of party opinion can divide Republicans and Democrats in securing and electing a ticket of representative business men to transact the business of this city. Nothing but the blindest fanaticism to a fetich of party politics can induce voters to confound the issue and split their strength. The only other excuse for the maintenance of party lines in a municipal election, especially when so grave an issue is involved, is found in the ambitions of professional politicians and the lust of office-hunters.

With the municipal government once more deliv-

ered into the hands of the Labor Union party, it is not difficult to predict what grave catastrophes would visit San Francisco. The confidence which has been restored in so large measure by the substitution of a Board of Supervisors composed of honest and efficient citizens, in the place of self-confessed boodlers, would be shattered. Capital would again draw in its horns and shrink from investment in a city controlled by the representatives of a class which, apart from its previous political record, stands perpetually for industrial agitation and upheaval. The re-election of the Labor Union ticket would give fresh heart to the agitators. More extravagant demands would be made and more insufferable tyranny would be projected. With the police force in its control, the Labor Union Party would feel secure in giving freer reign to the agitators in their promotion and operation of strikes. The long reign of industrial disturbance and social disorder which has so impeded San Francisco's destiny, maimed her prosperity, and marred her peace, would doubtless be repeated.

Such dangers are too real and too imminent for us to sit idly by without voicing a note of vehement protest against the unnecessary and utterly illogical division of forces for honest and efficient government in the campaign against a dangerous common enemy.

The principle of the "Open Shop," upon which depends the future peace and prosperity of this city, has been established successfully in two of our essential public utilities, one of which comprises a very large industry. It is of vital importance that this same principle should be asserted in next November's election. There is but one alternative—a return to Labor Union rule, with all its industrial disorder, lawlessness and gross inefficiency, or that the business of this city shall be administered by business men of integrity and ability, who will support the law, maintain the peace, and thus insure the prosperity of this community.

TUNGSTEN LAMP.

The latest known arrival in the field of incandescent lights is the Tungsten Lamp. Tungsten has long been known as a metal, but few have seen it except as a powder. Its alloys with iron are quite common. It had been difficult to obtain it pure, and in the impure state it was very promising as a filament material. It was impossible to draw it into a wire, as was done with tantalum, though a melted mass of it could be produced in an arc-furnace. Therefore, additional experiments had to be made. Filaments are now commonly produced from the fine powder, which is mixed with some kind of binder to form a paste, and after squirting through a die the resulting threads are subjected to some process to remove the foreign material. One of the simplest processes is to use sugar paste and to drive out the residual carbon in an inert atmosphere. Like its competitors, the osmium and the tantalum filaments, about 2 feet of wire are necessary for 110-volt lamps. Its melting-point is higher than either of these, and satisfactory lamps are made, giving 80-candlepower for 100 watts, as compared with 32 candlepower per 100 watts, given by the carbon filament lamp.

INCREASING BOILER EFFICIENCY.

At the fuel-testing plant of the U. S. Geological Survey at St. Louis, Mo., Mr. Walter T. Ray, acting under the direction of Prof. S. P. Breckenridge, is making experiments with small multitubular boilers designed to absorb a greater amount of heat per unit of surface. This is but a practical application of the idea of Mr. John Perry, that a high velocity of gases parallel to the heating surface removes the dense film of cold gases sticking to the surface. So, by using a forced draft to put a large amount of gas through the boiler, at a very high speed, together with a finer subdivision of the heating surface and water streams, and a freer circulation of the water within the boiler, the efficiency is increased from ten to twenty times per unit of heating surface. This theory assumes that the boiler absorbs by convection, from the gases passing through it, the same percentage of heat.

PERSONAL.

John R. Cole is East.

E. D. Fletcher has been appointed City Engineer for Hoquiam, Wash.

C. C. Hillis, of the Electric Appliance Co., has returned to San Francisco.

W. P. Hurlburt is President of the Lewiston, Southeastern electric line, between Grangeville and Lewiston, Idaho.

TRADE CATALOGUE.

Bulletin No. 4,521, from the General Electric Co., Shenectady, N. Y., illustrates and describes General Electric floor outlet boxes.

Bulletin No. 1 from the Holophane Company, New York, explains the Holophane system of illumination. It presents illustrations of various types of globes and reflectors for every service, explaining the advantages for that service. As a catalogue it is invaluable to the illuminating engineer.

The "General Electric Review," as issued in the interests of the General Electric Company, of Schenectady, N. Y., contains a number of articles of universal interest. First among these is an article on "Electrical Engineering Perspective," by Prof. Henry H. Norris, in which he gives an illustration of the essential simplicity of electrical apparatus when viewed by one who has the ability "to see things in space." Prof. Elihu Thomson's address on the Panama Canal is printed with illustrations. Other timely and pertinent articles fill the rest of the forty-eight pages of this valuable publication.

LOCAL STOCKS AND BONDS

Furnished by Courtesy San Francisco Stock and Bond Exchange.

Outstanding	INTEREST	MISCELLANEOUS BONDS.	AUGUST 9		AUGUST 10		AUGUST 12		AUGUST 13		AUGUST 14		AUGUST 15	
			Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked	Bid	Asked
1,532,000	F & A	Associated Oil Co. 5%	78	80	78	80	78	80	78	80	78	80	78	80
2,250,000	M & S	Bay Counties Power Co. 5%	.....	95 ½	94 ½	.....	.....	95 ½	.....	95 ½	95	.....	95	.....
1,000,000	F & A	Cal. Central Gas & El. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
9,600,000	M & S	Cal. Gas & El. Gen. M. & C. T. 5%	.....	80	.....	80	79 ½	80	79 ½	80	.....	80	.....	80
900,000	J & J	California St. Cable Co. 5%	98	101	98	101	98	101	98	101	98	101	100 ¾	.....
2,000,000	J & J	Contra Costa Water Co. 5%	.....	100 ½	.....	100 ½	.....	.....	.....	100 ½	.....	100 ½	.....	100 ½
1,000,000	J & J	do do Gen. Mtg. 5%	.....	96	.....	96	.....	96	.....	96	.....	97 ½	.....	97 ½
623,000	F M A N	Edison Light & Power 6%	105	.....	105	.....	105	.....	105	.....	105	.....	105	.....
650,000	M & S	Ferries & Cliff Ho. Ry. 6%	103 ½	.....	103 ½	.....	103 ½	.....	103 ½	.....	.....	109	.....	109
671,000	A & O	Geary St. Ry. 5%	52	.....	52	.....	52	.....	52	.....	52	.....	52	.....
610,000	M & N	Honolulu R. T. & L. Co. 6%	105 ½	.....	105 ½	.....	105 ½	.....	105 ½	.....	105 ½	.....	105 ½	.....
300,000	A & O	Lake Tahoe Ry. & T. Co. 5%	.....	102 ½	.....	102 ½	.....	102 ½	.....	102 ½	.....	102 ½	.....	102 ½
500,000	J & J	Los Angeles Elec. Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
1,300,000	J & J	Los Angeles Gas & Elec. Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
5,000,000	A & O	Los Angeles Ry. 5%	109	.....	109	.....	109	.....	109	.....	107 ½	112 ½	107 ½	.....
1,000,000	A & O	Los Angele Lighting Gd. 5%	.....	103	.....	103	.....	103	.....	103	.....	103	.....	103
1,500,000	A & O	Los Angeles Pac. R. R., 1st Con. Mtg. 5%	102 ¾	.....	102 ¾	.....	102 ¾	.....	102 ¾	.....	102 ¾	.....	102 ¾	.....
3,030,000	M & S	L. A. Pac. R. R. of Cal. 5%	.....	101	.....	101	.....	101	.....	101	.....	101	.....	101
3,000,000	J & J	Market Street Cab'e 6%	108	.....	.....	110	.....	110	.....	110	.....	110	.....	110
3,141,000	M & S	do Ry., 1st Cons. Mtg. 5%	.....	106	.....	106	102 ½	.....	.....	104	.....	104	.....	105
100,000	A & O	Mill Valley & Mt Tamalpais S.Ry. 5%	103	.....	103	.....	103	.....	103	.....	103	.....	103	.....
4,751,000	A & O	Northern Ry. Co. of (Cal.) 5%	112	.....	112	.....	113	.....	113	.....	113	.....	113	.....
1,498,000	J & J	North Pacific Coast R. R. 5%	100 ¾	.....	100 ¾	.....	100 ¾	.....	100 ¾	101 ½	101	101 ½	101	101 ½
1,074,000	J & D	Northern Cal. Railway 5%	103	.....	104	.....	104	.....	104	.....	104	.....	104 ¾	.....
980,000	J & D	Northern Cal. Power Co. 5%	.....	97 ½	.....	97 ½	.....	97 ½	.....	97 ½	.....	99	.....	100
6,000,000	A & O	Northern Electric Co. 5%	.....	97 ½	.....	97 ½	.....	97 ½	.....	97 ½	.....	97 ½	.....	97 ½
1,000,000	M & S	Oakland Gas Light and H. 5%	104	.....	104	.....	104	.....	104	.....	104	.....	104	.....
1,374,000	J & J	Oakland Transit Co. 6%	110	.....	110	.....	110	.....	110	.....	109	.....	110	.....
1,600,000	J & J	Oakland Transit 5%	102 ½	.....	102 ½	.....	102 ½	.....	102 ½	.....	104 ¼	.....	104 ¾	.....
1,326,000	J & J	Oakland Transit Con. 5%	102	102 ½	102 ¾	102 ½	102 ½	102 ½	102 ½	102 ½	102 ¾	.....	.....	103
7,000,000	J & J	Oakland Traction Con. 5%	99	99 ½	99	99 ½	99	99 ½	99	99 ¾	98 ½	99 ½	98 ½	99 ¼
1,500,000	J & J	Oakland Water Co. gtd. 5%	.....	99 ½	.....	99 ½	.....	99 ½	.....	99 ½	.....	99 ½	.....	99 ½
2,000,000	A & O	Omnibus Cable Ry. 6%	108 ½	112	108 ½	112	108 ½	112	108 ½	112	108 ½	112	108 ½	112
1,149,000	S D M J	Pacific Gas Imp. 4%	.....	92 ½	.....	92 ½	.....	92 ½	.....	92 ½	.....	92 ½	.....	92 ½
8,494,000	J & J	Pacific Electric Ry. Co. 5%	103 ⅞	104	103 ¾	104 ¼	103 ¾	104	.....	104 ¼	.....	104	.....	104
4,491,000	J & J	Pacific Light & Power Co. 5%	.....	100 ¼	.....	100 ¼	.....	100 ¼	.....	100 ¼	.....	98	.....	98
3,000,000	J & J	Pacific Tel. & Tel. Co. 5%	.....	103	.....	103	.....	103	.....	103	.....	103	.....	103
350,000	J & J	Park & Cliff House Ry. 6%	.....	104	.....	104	.....	105	.....	104	.....	104	.....	104
250,000	J & J	Park & Ocean R. R. 6%	102	.....	102	.....	.....	104	.....	104	.....	104	.....	104
700,000	M & S	Powell Street Railway 6%	.....	107 ½	.....	107 ½	.....	107 ½	.....	107 ½	.....	107 ½	.....	107 ½
2,500,000	M & N	Sacramento Elec. Gas & Ry. 5%	100	101	100	101	100 ½	101	100 ½	101	100 ¾	101	.....	101 ¼
6,000,000	A & O	S. F. & S. J. Valley Ry. 5%	.....	114	.....	114	.....	114	112	114	112 ½	114	112 ½	114
3,000,000	J & J	S. F., Oak. & San Jose Ry. 5%	.....	104	.....	104	.....	104	.....	104	103 ½	.....	103 ½	.....
1,500,000	J & J	do do 2d Mtg. 5%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1,500,000	A & O	S. J. & S. Clara Co. R. R. 4½%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
642,000	A & O	Sierra Ry. of Cal. 6%	104 ¾	.....	104 ¾	.....	104 ¾	.....	104 ¾	.....	104 ¾	.....	104 ¾	.....
6,000,000	J & J	S. P. R. R. of Arizona 6% (1909)	101	101 ¼	101	.....	101	.....	101	.....	101	.....	101	.....
4,000,000	J & J	do do do (1910)	101 ½	.....	101 ¾	.....	101 ¾	102	101 ¾	102	101 ¾	.....	101 ¾	.....
5,116,000	A & O	S. P. R. R. of Cal. 6% (1912)	108	.....	108	.....	108	.....	108	.....	108	.....	108	.....
4,127,500	M & N	S. P. R. R. of. Cal., 1st c. gtd. 5%	114	.....	114	.....	114	.....	114	.....	114	.....	114	.....
3,533,000	A & O	S. P. Branch Ry. of Cal., 6%	123 ½	126	124	126	124	125 ½	123 ½	125 ½	123 ½	125 ½	123	125 ½
81,178,000	J & J	S. P. R. R. Co., 1st Ref'd'g. 4%	90 ¾	91 ¼	90 ¾	91 ¼	90 ½	.....	.....	91 ½	.....	91 ½	.....	91 ½
17,500,000	J & D	Spring Valley Water Co. Gen. Mtg. 4%	83	.....	83	.....	83	.....	83	.....	83	.....	83	.....
300,000	M & S	Stockton Gas & Elec. Co. 6%	100	.....	100	.....	100	.....	100	.....	100	.....	100	.....
2,000,000	J & J	United Gas & Elec. Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
20,000,000	A & O	United R. R. of S. F. 4%	70 ¼	70 ¾	70	.....	70	70 ½	69 ¾	70 ¼	70	70 ½	70 ⅜	71
2,500,000	M & N	Valleys Counties Power Co. 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
		Water Stocks.												
.....	.....	Contra Costa	.....	62	.....	62	.....	62	.....	62	.....	62	.....	62
6,000	Quarterly	Marin County	.....	62	.....	62	.....	62	.....	62	.....	62	.....	62
280,000	.....	Spring Valley Water Co.	20 ⅛	20 ¼	20 ⅛	20 ⅜	20	20 ⅛	20	.....	20	.....	20	20 ¼
		Gas and Electric Stocks.												
37,500	.....	Martel Power Co.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
9,340	.....	Mutual Electric Light Co. (Ctfs.)	4 ½	.....	4 ½	.....	4 ½	.....	4 ½	.....	4 ½	.....	4 ½	.....
37,336	.....	do (Extended Ctfs.)	12 ⅝	.....	12 ⅝	.....	12 ⅝	.....	12 ⅝	.....	12 ⅝	.....	12 ⅝	.....
40,000	Monthly	Pacific Lighting Co.	.....	67	.....	67 ½	.....	67 ½	.....	67 ½	.....	67 ½	.....	67 ½
12,000	.....	Stockton Gas & Elec. Co.	52	.....	52	.....	52	.....	52	.....	52	.....	52	.....
		Street Railroad Stocks.												
10,000	.....	California	.....	140	.....	140	.....	140	.....	140	.....	140	.....	140
10,000	.....	Geary	.....	41	.....	41	.....	41	.....	41	.....	41	.....	41
10,000	.....	Presidio	.....	25	.....	25	.....	25	.....	25	.....	25	.....	25
	Semi-an.	Associated Oil Co.	30	.....	30	31	30	31	30 ½	30 ⅝	0 ½	30 ⅜	29 ¾	30 ½
1,625	Quarterly	Mill Valley & Mt. Tamalpais S. Ry.	.....	110	.....	110	.....	110	.....	110	.....	110	.....	110
180,000	Quarterly	Pac. Tel. & Tel. Co. (Pfd.)	.....	95	.....	95	.....	95	.....	95	.....	95	.....	90
180,000	.....	Pac. Tel. & Tel. Co. (Common)	10	15	10	15	10	.....	10	.....	10	.....	10	15

Unlisted Securities

750,000	A & O	Bay Counties Power Co. 6%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
745,000	M & S	Blue Lakes Water Co. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,000,000	A & O	California Northwestern Ry. 5%	.....	108	.....	108	.....	108	.....	108	.....	108	.....	108
160,000	J A J O	Marin County Water 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
600,000	J & J	Risdon Iron Works 5%	.....	100	.....	100	.....	100	.....	100	.....	100	.....	100
500,000	M & S	S. F. Dry Dock 5%	.....	109	.....	109	.....	109	.....	109	.....	109	.....	109
8,000,000	M & N	S. F. Gas & Electric 4½%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
3,926,000	J & J	S. F. & North Pacific Ry. 5%	104	.....	104	107 ½	104	107 ½	104	106 ½	104	.....	104	.....
5,500,000	J & J	South Pacific Coast Ry. 4%	.....	95	.....	95	.....	95	.....	95	.....	95	.....	95
.....	.....	Standard Electric Co. 5%	.....	85	.....	85	.....	82	.....	82	.....	82	.....	82
.....	.....	do do Gtd. 5%	.....	85	.....	85	.....	85	.....	85	.....	85	.....	85
750,000	J & J	Sunset Tel. & Tel. Co. 6%	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
2,250,000	A & O	Sunset Tel. & Tel. Co. 5%	.....	103 ½	.....	103 ½	.....	103 ½	.....	103 ½	.....	103 ½	.....	103 ½
1,000,000	M & N	Sutter Street Railway 5%	.....	105	.....	105	.....	105	.....	105	.....	105	.....	105
		Stocks.												
50,000	Monthly	Gas Consumers' Association	.....	20	.....	20	.....	20	.....	20	.....	20	.....	20
100,000	Monthly	Northern Cal. Power Co.	24	25	24	25	24	25	24	25	24	25	24 ¼	25
.....	.....	Pac. Gas & Elec. (Pfd.)	.....	.....	39	.....	38	40	.....	38	45	50	42 ½	.....
.....	.....	Santa Cruz Port. Cement	.....	55	.....	55	.....	55	.....	55	.....	55	.....	55
.....	.....	Standard Port. Cement (New)	.....	55	.....	55	.....	55	.....	55	.....	55	.....	55
$0,000	Monthly	Truckee Electric Co.	15	.....	14 ⅜	.....	14 ⅜	.....	14 ⅜	.....	14 ⅜	15 ⅛	14 ⅛	15 ⅛

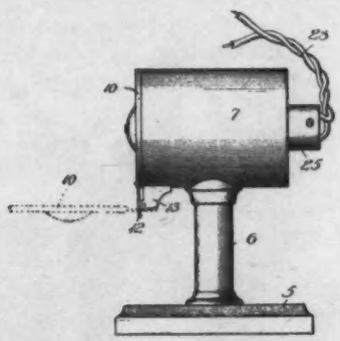
PATENTS

Electric, Gas and Water.

Specially reported for the Journal of Electricity, Power and Gas.

ELECTRIC MUFFLE-FURNACE. 861,744. Albert Marsh, Lake Bluff, Ill., assignor to Hoskins Co., Chicago, Ill., a corporation of Illinois. Filed February 18, 1907. Serial No. 358,001.

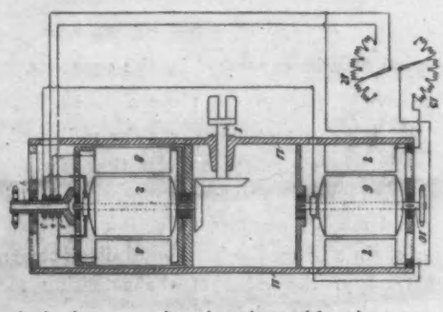
1. In an electric muffle-furnace, the combination of a housing having a head at one end provided with an aperture, a muffle removably insertible into said housing and composed



of refractory material with an electrical resistance element contained therein having terminals on an end of the muffle, and an electric coupling-head adapted to engage with said terminals and housing and forming a removable fastener operating to clamp the housing-head between it and the adjacent muffle-end.

DYNAMO-ELECTRIC VARIABLE-SPEED AND REVERSING GEARING. 861,931. Martin Albrecht, Friedberg, Germany, assignor to Felten & Guilleaume-Lahmeyerwerke Actien-Gesellschaft, Frankfort-on-the-Main, Germany. Filed February 13, 1907. Serial No. 357,208.

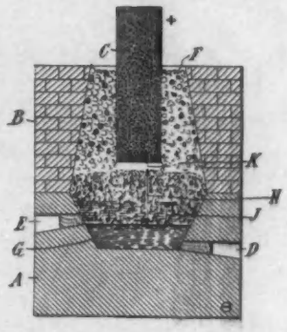
1. In a dynamo-electric variable speed gearing, the combination with a prime mover of a dynamo electric gear comprising a field element and an armature element adapted to be



rotated relatively to each other by said prime mover, means operatively connected with one of said elements and adapted to be rotated by the reaction exerted by said elements on each other, an electrical motor having a movable member adapted to turn about the same axis as the dynamo electric gear, a circuit including the armature windings of said motor and of said dynamo electric gear, and means adapted to be rotated by said motor.

ELECTRIC SMELTING. 861,280. Paul L. T. Heroult, La Praz, France, assignor to Societe Electro-Metallurgique Francaise, Froges, France. Filed April 25, 1906. Serial No. 313,580.

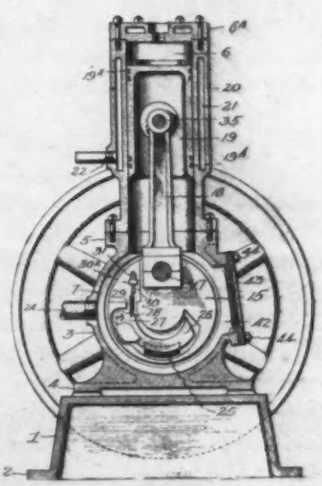
1. In the smelting of iron ore in an electric furnace having an electrode from which the current passes to the base of the furnace, the process which consists in feeding a charge of ore and carbon in such proportion that the carbon forms a magma below the electrode and the ore is fused above the



column and is reduced in passing therethrough and the molten iron collects at the bottom, and adding lime to the charge in quantities sufficient to form a scale of desired thickness at the sides of such column, thereby diminishing the cross-section of the column and thus concentrating the energy of the current through such cross-section, and raising the electrode so as to increase the length of the column and to increase the degree of reduction.

GAS ENGINE. 861,673. Alfred N. Parnall, Florence, Colo. Filed May 7, 1906. Serial No. 315,598.

1. In an explosive engine receiving the explosive charges through the crank case, a valve in the crank case controlling the admission of the explosive mixture to the explosion chamber, and a centrifugal governor controlling the valve mounted upon the crank within the crank case.



2. In a two-cycle explosive engine, a crank disk normally closing the passage from the crank case to the explosion chamber of the engine, a valved port in said crank disk movable to open communication between the crank case and the explosion chamber of the engine, and means for varying the effective aperture of said port in accordance with the speed of the engine.

INDUSTRIAL

KELVIN TYPE SOLENOID AMMETERS AND VOLTMETERS.

By M. C. Rypinski and H. W. Young.

Some of the earliest forms of indicating meters were constructed on the solenoid principle depending for their action upon the pull of a soft iron core suspended within a solenoid and acting in opposition to the pull of gravity on the counterbalancing weights. An indicating pointer attached to the suspended element arranged to pass over a suitably graduated scale, giving by its indication a direct measure of the current value producing the deflection.

This principle has been developed in various ways by instrument designers whose efforts have resulted in many

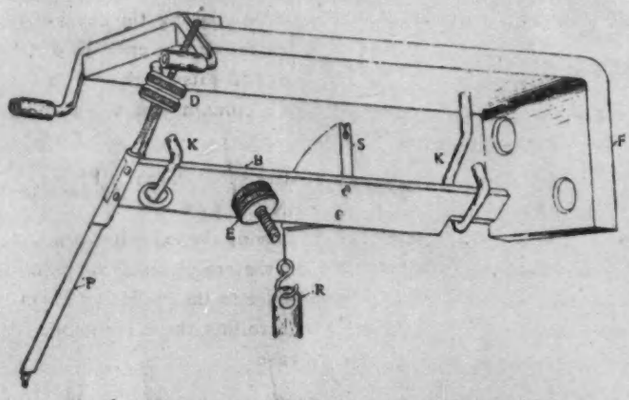


FIG. 1. MOVING ELEMENT OF KELVIN TYPE METER

meritorious designs, although the majority have not succeeded in producing a device giving a uniform scale distribution. In the Kelvin type of solenoid instruments this feature has been attained by employing long solenoids having intense magnetic fields and used in connection with a highly saturated armature and special control mechanism.

Construction of Kelvin Ammeter—Figure 1 illustrates the arrangement of the various bearing and controlling parts. "F" is a supporting bracket attached to the meter base; "KK" phosphor bronze bearing hooks shaped to knife edges at bearing points; "B" a hardened steel beam drilled, countersunk and shaped to form knife edge bearings resting on hooks "KK." This form of construction insures bearings having minimum friction, easily removed for inspection, not easily damaged and of long life.

Moving Element—Fastened to "B" is a grooved pulley sector "S" supporting a silk cord to the lower end of which is suspended the iron wire core "R." The pointer "P," zero adjusting weights "E" and full scale adjusting weights "D," all rigidly attached to "B" complete the moving system.

Operation—Looking at the system from a mechanical point of view it will be seen to comprise a lever arrangement in which a variable straight line pull of constant radius is opposed to a constant pull of variable leverage. The variable pull is that due to attraction of the wire by the magnetic field generated by current passing through the coil, for which pull, section "S" provides a constant leverage. The action of gravity on the controlling weighs provides the constant opposed pull and movement of the weights, through a circular arc away from the vertical line of support, gives to the opposed pull a variable leverage.

With no current flowing (pointer indicating zero) a condition of equilibrium exists, in which the center of gravity of all that part of the moving system (except the armature) is displaced a sufficient amount to the right to counterbalance the iron wire. With current flowing through coil, a magnetic field is generated which, attracting the iron, exerts a pull on the system causing the pointer to move to a position where the displacement is sufficient to re-establish equilibrium. This

KELVIN TYPE AMMETER

latter condition may be expressed by the equation,

$$pr.=(W-w)\ r'\ \sin a$$

where p= the pull due to current, r= the radius of sector S, (W-w)= the weight of the system less that of the armature, r'= the radius of (W-w) assumed concentrated as its center of gravity, and a= the angular deflection of (W-w) due to the current; r' sin a being the horizontal displacement or leverage of (W-w) pr the value of the actuating torque and (W-w) r' sin a the opposed controlling torque.

This equation shows that the controlling torque varies according to a sine function of the angular deflection and that the actuating torque must also vary according to a similar since function of the current, if a uniform scale distribution is to exist. The value of the actuating torque depends upon the variable p and this in turn depends, as a rule, upon three variables:

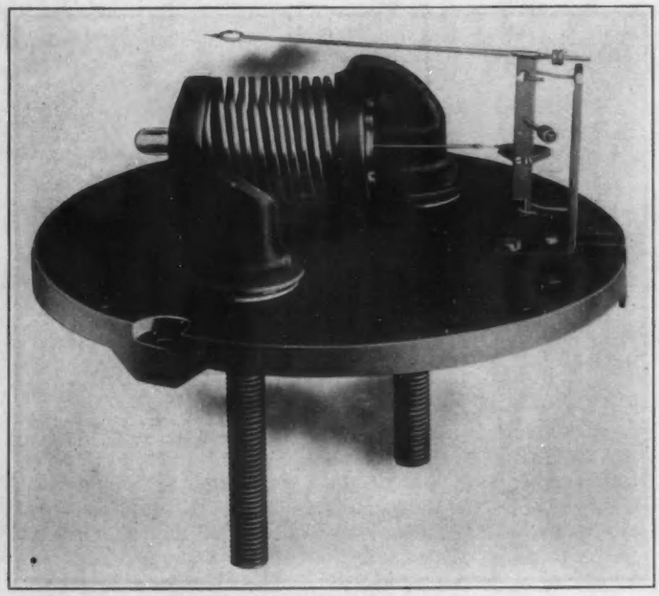
First—The current, in its effect upon the magnetizing force of the coil. Second—The current, in its effect upon the induction of the iron armature. Third—The position of the armature with reference to the coil.

It is an interesting fact that with a coil and armature arranged as in this meter, the third variable follows a sine law. By saturating the armature its induction becomes constant, thus eliminating the second variable and with it the second power of the current, which would otherwise give a contracted scale, following the law of squares.

Deadbeat Qualities—The meter indications are absolutely "Aperiodic" or deadbeat, the indicating pointer coming to rest immediately after any change or fluctuation of the line current or voltage.

This highly desirable quality is attained by employing a liquid damping system consisting of an oil filled glass tube inserted in the solenoid core, thus suspending the iron armature in oil. (See figure 2.) Any movement or oscillation of the armature is instantly checked or damped without introducing friction, errors or impairing the meter's accuracy.

This form of damper is simple, effective, permanent and



KELVIN TYPE AMMETER (INTERIOR VIEW)

not easily deranged. The only possible objection to its use is danger of oil spillage during installation, but as the oil chamber is not filled until all other work is completed, the danger of spillage is negligible. The damping may be easily varied by changing the quality of oil.

Effect of External Magnetic Fields—The meters are free from disturbing effects of stray or external magnetic fields due to the intense internal uniform field of the solenoid which is much stronger than, and therefore unaffected by, any probable external or stray field.

This freedom from disturbance is further safeguarded and assured by making the enclosing case of iron, effectually shielding the measuring element from abnormal disturbances.

The scales are very satisfactory as to length legibility and distribution. They subtend an arc of 70 degrees, have a length of 6" and have practically uniform divisions throughout the entire area, which is particularly desirable in ammeters connected to circuits subject to light loads.

Limitations in Ammeter Capacity—Owing to the fact the entire current is carried through the measuring coil it is impractical to supply windings in excess of 1000 amperes and when D. C. meters are desired to measure currents in excess of this value the shunted type of moving coil ammeter should be employed. When A. C. meters of high ampere capacity or for use on high voltage circuits are required it is customary to employ an ammeter having a 5 ampere winding and operated from a series transformer having a 5 ampere secondary and a primary suitable for connection in series with the main circuit.

Voltmeters—Voltmeters operate upon the same principle as the ammeters, but employ a fine wire coil in series with an external resistance. A. C. voltmeter in excess of 750 volts employ 100 V. (normal) windings and are connected to the 100 V. secondary of a voltage transformer whose primary is connected across the line.

Checking Calibration—An extremely simple and convenient method of checking the calibration has been devised and enables the user to determine if the meter is correct without the aid of standard instruments. This checking is effected by the use of a small calibrating weight which, after the meter is installed and leveled, is slipped over a silk cord so as to rest on the top of the armature. On the scale is placed a red mark to which the pointer will deflect if the calibration is correct, but if the calibration has changed, the pointer will indicate "high" or "low" of this mark.

Recalibration of Meters—If a meter should require recalibrating it may be effected as follows: If the meter reads "low" the counterweight D (figure 1) should be raised on its support; if "high" the weight should be lowered. The weight E is used to adjust the zero position of pointer if such adjustment be necessary and this weight should not be used for calibrating purposes.

It is not generally known that Pittsburg is one of the largest manufacturers of electric illuminants, a distinction which is due to the enormously increasing business of the Nernst Lamp Company. This concern, which is one of the subsidiary Westinghouse interests, began some years ago to introduce the Nernst Lamp, an illuminant invented by Professor Walter Nernst, of the University of Goettingen, Germany, and somewhat different from the incandescent as well as the arc lamp. The illuminating part of this lamp consists of two cylindrically shaped bars of rare earths, which, when the electric current is passed through them, diffuses a brilliant white light, more nearly approaching daylight than any other form of illumination.

Since these lamps were brought upon the market, some of the largest offices, and public and store buildings in this country have been installed with them. Within the last week the company has received contracts which represent a larger number of candle power than any individual lighting contract that has ever been made since electric lamps became the popular form of artificial lighting. One of these contracts, from the Baltimore Electric Company, calls for lamps aggregating 1,300,000 candle power, and another from the Marshall Field Company, of Chicago, for lighting their dry goods store, calls for 700,000 candle power, making a total of 2,000,000 candle power. The Marshall Field people only decided upon the Nernst Lamp after they had made an exhaustive test lasting over two years of every other form of modern artificial illumination.

Another contract which the company is now turning out in its shops is 1,000,000 candle power for the new terminal station of the Pennsylvania Railroad in New York City.

ALLIS-CHALMERS ENGINES IN THE PUMPING PLANT OF THE OMAHA WATER COMPANY.

By Willis Collins.

From the standpoint of high economy continuously maintained throughout a long period of time, the central station of the Omaha water works system, equipped with Allis-Chalmers pumping engines, has a record of more than ordinary interest, as will be seen from the following account:

The construction of this system was begun in 1880, when the population of the city was only 30,000, and completed in 1883. When completed, the system had twenty-eight miles of water mains and 250 fire hydrants. The Missouri River was the source of supply. The water was first pumped up about thirty feet to four large basins on the river side, where sedimentation took place, considerably clarifying the water. The clarified water flowed to the suction of the high-lift pumps, which discharged to a 10,000,000 gallon reservoir on Walnut Hill. Water was supplied to the City of Omaha, South Omaha, and the suburbs of Dundee, Florence and East Omaha. In 1886 the average daily consumption was about 6,000,000 gallons.

In 1887 a new central pumping station was built at Florence, Neb., which is located several miles up stream, on the Missouri River, beyond all danger of sewage contamination to the water. The plant is surrounded by 107 acres of parked ground, and is called by the Indian name for pure water, viz., "Minelusa." The mechanical equipment of this plant is particularly fine. Although some of the machinery has been in operation for nearly twenty years, the record for economy and reliability is most creditable and comparable with pumping plans built ten or fifteen years later. The low-service and high-service pumps are installed in the same station, and supplied with steam from a common boiler plant. The first installation consisted of two 12,000,000 gallon vertical compound, crank-and-fly-wheel pumping engines, to work under a head of seventy feet for the low-service, and one 18,000,000 gallon vertical, triple-expansion pumping engine, to work under a head of 310 feet for high-service, discharging to reservoir and distribution system. The low-service pumps deliver the water to a series of sedimentation basins on the bank above the river; these basins being arranged with a series of cascades between adjacent basins, with water levels carried so as to give a drop of two or three feet over each series of cascades. The cascades have sills perfectly level, and long enough to carry the maximum amount of water in a very thin sheet. Air is admitted freely behind the falling water. This complete aeration of the water, alternated with complete rest in the sedimentation basins, has a wonderful clarifying effect, and practically removes all of the red silt from the river water by the time it reaches the last basin. The clear water flows to the high-lift pumps, under a slight head.

In 1898 the increase in water consumption demanded additional pumping capacity, and an 18,000,000 gallon vertical compound pumping engine was installed for low-service duty, and a little later, in 1902, a 20,000,000 gallon vertical triple pumping engine was installed, to give increased capacity for the high-service system, making, in all, five pumping engines, with an aggregate capacity of 80,000,000 gallons per twenty-four hours.

All of these pumping engines have records for reliability; there has never been a break requiring a shut-down for repairs.

The first vertical, triple-expansion pumping engine has the following cylinder diameters: H. P. 40"—I. P. 70"—L. P. 104", and the stroke of all is 60". These cylinder sizes were very much larger than anything ever designed for pumping-engine work at that time. The total weight of the machine was about one and one-half million pounds. The introduction of this unit reduced the consumption of fuel fifty per cent, and for some years was claimed to be the most economical pumping-engine unit in service, requiring but one and one-half pounds of coal per horsepower per hour.

The second vertical, triple-expansion pumping engine has steam cylinders of the same diameters as corresponding cylinders on the first engine, but the stroke is increased to 66". Each pumping engine makes twenty revolutions per minute, and the second machine has ten per cent greater capacity, on account of the longer stroke. The second machine is of the "Self-Contained" type, with the steam engine supported by the pump chambers.

There are now 230 miles of water mains, and about 15,000 service connections to the Omaha water system.

DEATH OF WILLIAM G. BARRETT.

The gas fraternity has lost one of its oldest and best beloved members by the death of William G. Barrett, of Oakland, California, who for nearly fifty years has been identified with the lighting interests of San Francisco.

Mr. Barrett was born in Chester, Vt., December 12th, 1822, and crossed the plains in 1850 to the Placerville region in California.

In 1860 he became Collector, and in 1862 Cashier and General Bookkeeper of the San Francisco Gas Light Company, while in 1877 he was elected Secretary and Treasurer, holding this position through the various mergings and successive ownerships of the San Francisco lighting interests until 1902, when he was retired as Secretary emeritus of the San Francisco Gas & Electric Co.

Mr. Barrett was one of the early members of the old Union Club, and afterwards of the Pacific Union, as well as of the Bohemian Club, of San Francisco.

When the Pacific Coast Gas Association was formed, July 11th, 1893, the deceased signed the roll of Charter Members, number four, and on July 16th, 1902, he was unanimously elected an Honorary Member of the Pacific Coast Gas Association. During these years, he was a constant attendant upon the meetings of the Association, and, although not an active participant in the discussions, his genial and kindly presence, and the love which we all bore him, brought sunshine into our meetings.

Mr. Barrett died at his home in Oakland on the morning of Thursday, August 8th, 1907, after a brief illness. Besides his widow, he leaves a son, Charles L. Barrett, who succeeded to his father's position in the San Francisco Gas & Electric Co., a daughter, Mrs. Stetson G. Hindes.

The Pacific Coast Gas Association was represented among the pall-bearers at the funeral, which occurred Sunday, August 11th, at Oakland, California, and sent a floral tribute in the form of the badge of the Association. Floral pieces were also sent by employees of the San Francisco Gas & Electric Co., all of whom looked upon Mr. Barrett as a dear friend and counsellor.

"His youth was innocent; his riper age
Marked with some act of goodness every day;
And watched by eyes that loved him, calm and sage,
Faded his late declining years away.
Meekly he gave his being up, and went
To share the holy rest that waits a life well spent."

NEWS NOTES

ELECTRIC RAILWAYS.

Newport, Wash.—It is said that development work on the water power proposition at Albeni Falls, two miles from Newport, will be commenced by August 15, and that the electric railroad between this point and Spokane will be in operation within a year. The power company expects to develop 30,000 horsepower at Albeni Falls. This will leave about 25,000 horsepower to be sold.

Hood River, Ore.—A meeting was held last week between members of the Hood River Commercial Club and Edward E. Goudy, Western manager for the Wallace-Coates Engineering Company. The object of the meeting was to provide means for the preliminary cost looking toward the survey for an electric trolley line to be built through the Hood River Valley. The cost of the preliminary work was estimated at $1500. The negotiations proceeded no farther.

Wallace, Idaho.—When the Chicago, Milwaukee & St. Paul Railway reaches the heavy grades in the Coeur d'Alene Mountains it will use electric power generated along the swift water of the upper St. Joe River. For this purpose the Idaho Water & Electric Company recently incorporated here with a capital of $500,000, was formed. The incorporators are Charles G. Dawes of Chicago, formerly comptroller of the currency; Senator J. L. McLear, of Coeur d'Alene; P. J. Scallon and Maude Thornton, also of Coeur d'Alene. It is the intention now to construct a series of sixteen dams on the St. Joe River harnessing the power there and transmitting it to the point where the big tunnel enters the Coeur d'Alene Mountains in Montana and continuing its use through the heavy grades of Idaho and Washington.

TELEPHONES.

Hinsdale, Mont.—The Moore telephone line is now completed between this place and Glasgow.

Portland.—The Pacific Telephone Company is completing its exchange at Mount Tabor at an expense of over $10,000.

Medford, Ore.—Work on a prospective line between this place and Blue Ledge has begun. F. C. Page is president of the company.

Deerhorn, Ore.—Five different telephone lines will soon be in operation between this place and Springfield, one now being constructed.

Cheney, Wash.—Wm. T. DuBois, who was recently granted a franchise, has a force of men erecting poles for installation of the system which must be in operation October 1st.

Renton, Wash.—Renton Telephone Company applied for an injunction against Pacific Telephone & Telegraph Company to restrain it from removing the Renton Company's lines from poles in Kennydale. Both companies claim leases of the poles.

Salem, Ore.—Mayor Rodgers has ordered the Northwest Long Distance Telephone Company to remove its poles and wires from the streets, as it has no franchise. The Telephone Company claims a franchise by arrangement with the Home Telephone Company.

Edmonton, Alta.—Part of the material for the Lormier Automatic Telephone system that is being installed in the city will be shipped by the Canadian Machine Telephone Company from Toronto and will arrive here in a few weeks. The remainder of the machinery will be shipped shortly.

POWER AND LIGHT.

Yegen Bros., of Billings, Mont., propose to install an electric light plant at once.

Edmonds, Wash.—W. W. Glazier, of Marysville, presented an application for an electric light and power franchise.

George Fowlie and George Brecken have leased the Sherman electric light plant at White Sulphur Springs, Mont., and will operate it.

An addition is under construction to the power plant of the Wilmot (S. D.) electric light and waterworks station. It will cost about $2,000.

Kalispell, Mont.—Flathead Water Power Co. is building two power houses, of concrete and brick, in each of which 1,000 horsepower will be generated, on the Big Fork.

Monroe, Wash.—The new two-phase dynamo at the light station has been installed, and a day current for power will now be furnished to customers wanting it. For commencing, the power will only be supplied in the afternoon.

Lewiston, Ida.—The large increase in business of the Lewiston Gas Co. necessitates the immediate installation of two new retorts in the company's plant. This addition will double the capacity of the plant. The company's mains will also be extended.

North Yakima, Wash.—Under the supervision of Dr. M. Schuman and R. Green, of Portland, the big power project at Packwood Lake, seventy-five miles away, is going rapidly ahead. It is believed that this is one of the Northwestern Co. projects, and that power is to be sold in Seattle and Portland.

Portland, Ore.—Plans have been completed for the erection of a $1,000,000 power plant on the headwaters of the Sandy River, a few miles east of this city, to furnish electric power for the United Railways, which is building an interurban line between Portland and Salem. Negotiations are now being conducted with eastern capitalists with the purpose of financing the construction of the plant.

FINANCIAL.

Alameda, Cal.—The City Council has directed the City Attorney to prepare ordinances to call a bond election to vote upon the issuing of bonds for an electric light plant improvements, amounting to $50,000.

Sacramento, Cal.—At the meeting of the State Board of Equalization, the Northern Electric Co. was represented by George E. Springer, Tax Agent, and Attorney A. M. Seymour. Their report shows 55.44 miles of track, valued, with the franchise and rolling stock, at $126,895. There are 40.30 miles in Butte County, 14.09 in Sutter, and 1.02 in Yuba. The rolling stock is valued at $22,000. The gross earnings are given as $99,315.28, the operating expenses as $61,303.44, and the net profits, $38,011.84.

Sacramento, Cal.—The Yosemite Valley Railroad Company appeared before the State Board of Equalization through J. H. Ellis, its representative. It has 51 miles of track operated in this State, the roadway, roadbed, and rails being valued at $96,000. Of this, 26.35 miles are operated in Merced County and 24.65 miles in Mariposa County. Its operations consist chiefly of transporting construction material, and it has produced no revenue. El Portal is the end of the road, and a postmaster was appointed lately, but has no business to attend to at present, as the Southern Pacific carries mail to Wanona. Express matter beats the mail into the valley 24 hours. The road's earnings were $20,216.75, and its operating expenses $45,462.60, as it is only half completed, and has not yet arrived at the paying point.

San Francisco, Cal.—In an interview, John A. Britton, president of the Pacific Gas & Electric Co., says: "After increasing its capital stock from $15,000,000 to $35,000,000, at a meeting of stockholders to be held in October, the corporation will be in a position to redeem the outstanding bonds of its various subsidiary companies throughout the State as they fall due. It will also enable the company to sell new bonds in a blanket issue to provide for improvements made by subordinate concerns. It is a simple and convenient plan of corporation finance. The value of the properties held by the California concern is about $55,000,000, on which the capitalization has been comparatively small—only $15,000,000. The directors have decided to increase the capitalization by an additional $20,000,000, to comply with the law relative to the necessary proportion between capital stock and bonds issued. We will then be able to sell new bonds and make one issue take care of the indebtedness and improvements needed by the subsidiary companies. The bonded debts of these concerns will be refunded by means of the single blanket issue, which will be a more satisfactory plan of finance."

San Francisco, Cal.—An estimate of the value of the Spring Valley properties, to be used as a basis of negotiations between the city and that company, has been fixed by the executive committee of the allied commercial associations' committee. This estimate was embodied in a report which will be made to the larger committee, with the purpose that it be communicated to the Board of Supervisors, with a recommendation that the Spring Valley plant be purchased by the city at this figure, or less if possible. While the exact figures will not be made public until the larger committee has acted, it is known that they are considerably less than $31,000,000. Mayor Taylor has said that he is in favor of the purchase of the Spring Valley plant by the city, if it can be effected at a figure not greatly in excess of $25,000,000, and the estimate arrived at is within $3,000,000 of that amount. The market value of the bonds and stock of the company was included in the calculation, and the resulting figure was somewhat in excess of $31,000,000. From this was subtracted the value of the outside lands belonging to the company, which it is not considered necessary for the city to own. The value of these properties was recently determined at a meeting of the officers of the company and the representatives of the committee, and is said to have been in the neighborhood of $600,000.

WATERWORKS.

Vallejo, Cal.—Sealed bids are being received by the Commissioners of Public Works for furnishing 400, more or less, ⅝-inch disk water motors, heavy composition body, bronze train gear, disks to be constructed to eliminate all thrust, rubbing or jamming agains. diaphragm.

Los Angeles, Cal.—Water Superintendent Mulholland estimates that 5,780 tons of pipe required next year will cost $289,000; the new Buena Vista pump, $65,000; enlargement of conduit, $65,000; boilers and air compressors, $30,000; reservoir roofs, $39,000; total, $478,000. The Board asked for specifications for material and machinery.

Sacramento, Cal.—On the 15th inst. all plans in prize competition for premiums for a filtration plant for the city will be in, and soon after they will be opened and submitted to expert examination. Should there be in the lot a feasible plan that is acceptable to the City Trustees a bond issue will be proposed to the people to realize means for putting the plan in operation.

San Francisco, Cal.—The project to acquire reservoir sites for a San Francisco water supply in the Hetch-Hetchy and Lake Eleanor watersheds is not to be interfered with by the Sierra Ditch and Water Co., according to its chief engineer and manager, William Hall. The company has acquired the right to use a number of reservoir sites within the watershed of the Cherry-Eleanor branch of the Tuolumne River, says Hall, solely for the purpose of storing, distributing and selling waters for irrigation and other public purposes. The engineer denies the report that his company has become allied with the Turlock and Modesto irrigation districts in their opposition to San Francisco's Hetch-Hetchy project.

INCORPORATIONS.

Fresno, Cal.—The Lorene Oil Co. has been incorporated with a capital stock of $500,000 by Joseph Seeley, J. W., S. B. Pauson, of San Francisco, B. Lowenstein, of San Francisco, C. G. Wilcox, of Oakland, and John Hinkel, of Berkeley.

ILLUMINATION.

San Francisco, Cal.—The offices of the California Light and Fuel Co. have been removed to 1214 Polk Street.

Ryolite, Nev.—Mr. Schloss, of the Nevada Gas, Light & Power Co., says a gas plant will be installed in Goldfield and Ryolite.

Oakland, Cal.—William G. Barrett, for many years identified with the lighting interests of San Francisco, after an illness of more than two months, died at his residence in Oakland last week.

Sacramento, Cal.—The Board of Supervisors has passed an ordinance granting the right, privilege, and franchise of laying and maintaining gas pipes, mains and conduits in so many parts of the public highways, streets and alleys as the grantee may elect, to the Sacramento Electric, Gas & Railroad Co., for a term of 50 years.

Los Angeles, Cal.—The Los Angeles Gas and Electric Company will install 10,000 feet of new gas mains in the southwestern district of the city at once, according to announcement made by the company. The new mains will be twelve, sixteen and twenty-inch size, and will connect with the company thirty-inch main. The cos of the extensions will be $40,000.

Los Angeles, Cal.—The installation of the new electric lighting system at Bay City has begun. Handsome ornamental lighting posts, similar in character to those on Hill Street, Broadway, Spring Street, and Main Street, Los Angeles, will be used. Work is progressing rapidly on the new pavilion at the foot of Main Ctreet, Bay City, on the ocean front. There are many campers at Anaheim Landing, and altogether Bay City is enjoying a very prosperous summer season.

San Francisco, Cal.—The Supervisors' Artificial Lights Committee has considered the award of contracts for the lighting of streets and public buildings, but postponed action. John A. Britton said that the appropriation for the present fiscal year was $275,000, against $325,000 for 1905-1906, but that the gas company was restoring all of the lights that were in place before the disaster. Mr. Britton explained that there were 1,613 arc lights and 4,610 gas lamps in service at the present time, and that complaints about the lack of lights in Hayes, Valencia, Dupont and other streets would be attended to as fast as possible. He said that the United Railroads was paying $84 yearly for each of the 248 lamps in Market Street, and the 52 in Sutter Street. The committee cited the officials of the United Railroads to appear at its next meeting.

POWER AND LIGHT.

Willows, Cal.—The Snow Mountain Power Co. has been granted a franchise by the Board of Supervisors to erect poles and string wires for the purpose of carrying electrical power along public highways and in the streets and alleys of unincorporated towns of the county.

Bishop, Cal.—The manaegment of the Black Canyon Gold Mining Co. has bought of the Nevada Machinery and Supply Co., a complete power plant, consisting of engines, air compressors, power drills, and all th emodern appliances for up-to-date work in rapid mine developments.

San Francisco, Cal.—Miller & Lux will install a complete power plant for their new abattoir and packing house between First and Second Avenues, east of Kentucky Street. The plant will comprise boiler capacity sufficient for the packing house and for refrigerating machines and electric plant.

Eureka, Cal.—L. J. Nelson claims 2,000 inches of water from Mud Creek and its tributaries, and from Netuckett Creek, on the Klamath River, above Orleans, for mining, power irrigation and domestic purposes. He also claims 1,000 inches of water from Roseline Creek and its tributaries on Klamath River, above Orleans, for mining, power, irrigation and domestic purposes.

TRANSPORTATION.

Pasadena, Cal.—M. A. King, of Los Angeles and Glendale, has been in conference with city officials in behalf of parties who claim to have found a short route for an electric line via Eagle Rock.

San Diego, Cal.—A new concurrent resolution to grant a franchise to E. Bartlett Webster has been filed. It contains new provisions, including one to the effect that at least $1,000 must be bid.

Bakersfield, Cal.—Glass & Fisher have secured the contract for the erection of a new $20,000 reinforced concrete and steel power house, for the Visalia Electric Railroad Co., at Exeter. The new building will be 85x65 feet in dimensions.

Los Angeles, Cal.—The North Pasadena Improvement Association, of which A. J. Toolen is president, is trying to secure an electric line from Hollywood, via Eagle Rock Valley and over Devil's Gate Canyon on the Arroyo Seco. Mr. King, of the Eagle Rock Bank, is interested.

San Francisco, Cal.—The Southern Pacific is planning to erect an electric plant at Dunsmuir to be used in furnishing power for the operation of its railway repair shops. Application has been made for permission to take 5,000 miners' inches of water from the Sacramento River at Dunsmuir to furnish the water power necessary to operate the dynamos.

San Francisco, Cal.—At the last meeting of the Board of Supervisors, Supervisor D'Ancona introduced a resolution directing the United Railroads to desist from the construction of an overhead trolley line on the outside tracks on Market Street between Sutter and the Ferry Building, and to remove the wires already put up. D'Ancona declared that the company had no right to use the tracks for that purpose, as the privilege had never been granted. He asked that the resolution be adopted, and then referred to the Public Utilities Committee in order to give the railroad company an opportunity to state its side of the case. Supervisor Molera said that he thought the United Railroads should be given a hearing before the resolution was formally adopted, and it was finally referred to the committee without action.

ILLUMINATION.

Sacramento—The Trustees have granted to the Sacramento Electric, Gas and Railway Company a franchise over certain streets and highways of Curtis, Oaks and Highland Park, to lay gas pipes, mains and conduits, for the purpose of distributing gas to those two places, and the territory contiguous thereto. The franchise cost $50.

Napa, Cal.—The Newman Mining and Prospecting Co., which was organized here about six months ago with a capital stock of $25,000, has purchased four and one-fifth acres of land in East Napa from Dolores Juarez. On this tract the Newman Company will bore two wells. The first to be drilled will have a depth of 1,000 feet. As soon as this is completed an oil well, which is to be 2,000 feet deep, will be commenced.

Sacramento.—The management of the Sacramento Electric, Gas and Railway Company is preparing to guard against a shortage of illuminating gas during the winter months. A storage tank is being constructed on the river front, which is to have sufficient capacity to store 500,000 feet of gas. It is estimated that this amount would supply the city in the event that any accident happened to interfere with the operation of the works. A large number of purifying pans are being placed in the plant.

Stockton.—The City Trustees of Stockton have been temporarily restrained, by injunction proceedings brought by the Stockton Gas and Electric Co., from enforcing the newly adopted ordinance regulating the rates of gas and electricity charged to consumers by the corporation. The company has also asked for a permanent injunction and for a judgment declaring the Council acted in excess of its authority in attempting to fix the rates. The hearing has been set for Tuesday, September 3d. The rates fixed by the Council were $1.25 per 1,000 feet for manufactured gas, 90 cents for natural gas, 7c a kilowatt of electricity for lighting, and 4 cents a kilowatt for electricity for power.

WATERWORKS.

Tucson, Ariz.—The town of Safford, Graham County, is preparing to install municipal waterworks and a municipal lighting plant.

Dunsmuir.—The Southern Pacific has filed on 5000 inches of water in the Sacramento River, stating in its notice that the water is claimed for the purpose of developing electrical power to be used in Dunsmuir.

San Francisco, Cal.—The Board of Supervisors has directed the public utilities committee to prepare declaratory ordinances preliminary to submitting the proposition deschibed to the voters at the special election in October, as well as to incur a bonded indebtedness for the acquisition of an auxiliary water system for fire protection.

Long Beach, Cal.—As a result of agitation for municipal ownership of the water system in this city, E. F. Harnes, president of the Long Beach Water Co., made a proposition to the City Trustees to take over the plant at a price agreed upon by a committee, appointed by the city, to take an invoice of the properties. Should the city decide not to own their own water plant, the company will go ahead with intended improvements of from $100,000 to $150,000, to bring the system up to the demands of the city. The proposition was placed on file.

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Henshaw, Bulkley & Co.
Rix Comp Air & Mach. Co.
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Alternators
Allis-Chalmers Co.
California Electrical Works

Aluminum Electrical Conductors
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Batteries, Primary
California Electrical Works
Gould Storage Battery Co.
Standard Electrical Works

Batteries, Storage
Western Electric Co.
Century-Klein Electric Co.
Gould Storage Battery Co.
Electric Storage Battery Co.
Tel and Elec. Equipment Co.

Blue Printing
Dietzgen Co., Eugene

Boilers
Henshaw, Bulkley & Co.
Moore, C. C. & Co., Inc.
Risdon Iron Works
Standard Electric Works
Tracy Engineering Co.
Hunt, Mirk & Co.

Boiler Compounds
Dearborn Drug & Chem. Wks.
Johns-Manville Co., H. W.

Buffers
Northern Electrical Mfg. Co.

Building Material
Johns-Manville Co., H. W.

Building Paper
Johns-Manville Co., H. W.

Circuit Breakers
Fort Wayne Electric Works
Century-Klein Electric Co.

Condensers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
Rix Comp Air & Mach. Co.
C. H. Wheeler Mfg. Co.

Conduits
American Circular Loom Co.
American Conduit & Mfg. Co.
Tel. and Elec. Equipment Co.
Century-Klein Electric Co.

Conduit Fixtures
American Conduit & Mfg. Co.
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.

Cooling Towers
O. C. Goeriz & Co.
Moore, Chas. C. Co., Inc.
C. H. Wheeler Mfg. Co.

Cross Arms
Century-Klein Electric Co.
Tel. and Elec. Equipment Co.

Dynamos and Motors
Allis-Chalmers Co.
Brooks-Follis Elec. Corp.
California Electrical Works
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Holtzer-Cabot Elec. Co.
Northern Elec. Mfg. Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co
Wagner Elec. Mfg. Co.

Elevators
Van Emon Elevator Co.

Electric Car Heaters
Johns-Manville Co., H. W.
Northern Electrical Mfg. Co.

Electric Grinders
California Electrical Works
Northern Electrical Mfg. Co.
Tel. and Elec. Equipment Co.

Electric Heating Devices
Johns-Manville Co., H. W.

Electrical Instruments
Cutter Co., The
Century-Klein Electric Co.
Fort Wayne Electric Works
General Electric Co.
Tel. and Elec. Equipment Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.

Electrical Machinery
California Electrical Works
Northern Electrical Mfg. Co.
Standard Electrical Works
Century-Klein Electric Co.

Electric Polishers
Northern Electric Mfg. Co.

Electric Railway Appliances
Pierson, Roeding & Co.
Johns-Manville Co., H. W.

Electrical Supplies
California Electrical Works
Century-Klein Electric Co.
Standard Electrical Works
Tel. and Elec. Equipment Co.

Electric Ventilating Fans
Century-Klein Electric Co.
California Electrical Works
Northern Electrical Mfg. Co.

Engines, Boilers, Heaters, etc.
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore, Chas. C. Co., Inc.

Electric Watchman's Clocks
Tel. and Elec. Equipment Co.

Engineers, Chemical
Smith, Emery & Co.
Moore & Co., Chas. C., Inc.

Engineers, Electrical
Standard Elec. Works
Tracy Engineering Co.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engines, Gas and Gasoline
Allis-Chalmers Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C., Inc.
Westinghouse Machine Co.
Hunt, Mirk & Co.

Engineers and Contractors
Brooks-Follis Elec. Corporat'n
Bylesby & Co., H. M.
California Electrical Works
Cannon, Edward F.
Hunt, Mirk & Co.
Century-Klein Co.
Copeland, Clem A.
Doble Co., Abner
Doble, Robert McF.
Cory, C. L.
General Electric Co.
Hunt, Dillman, Meredith & Allen
Jackson, D. C. & W. L.
Smith, Emery & Co.